The Wiltshire Wills

Feasibility Study

Humanities Advanced Technology and Information Institute

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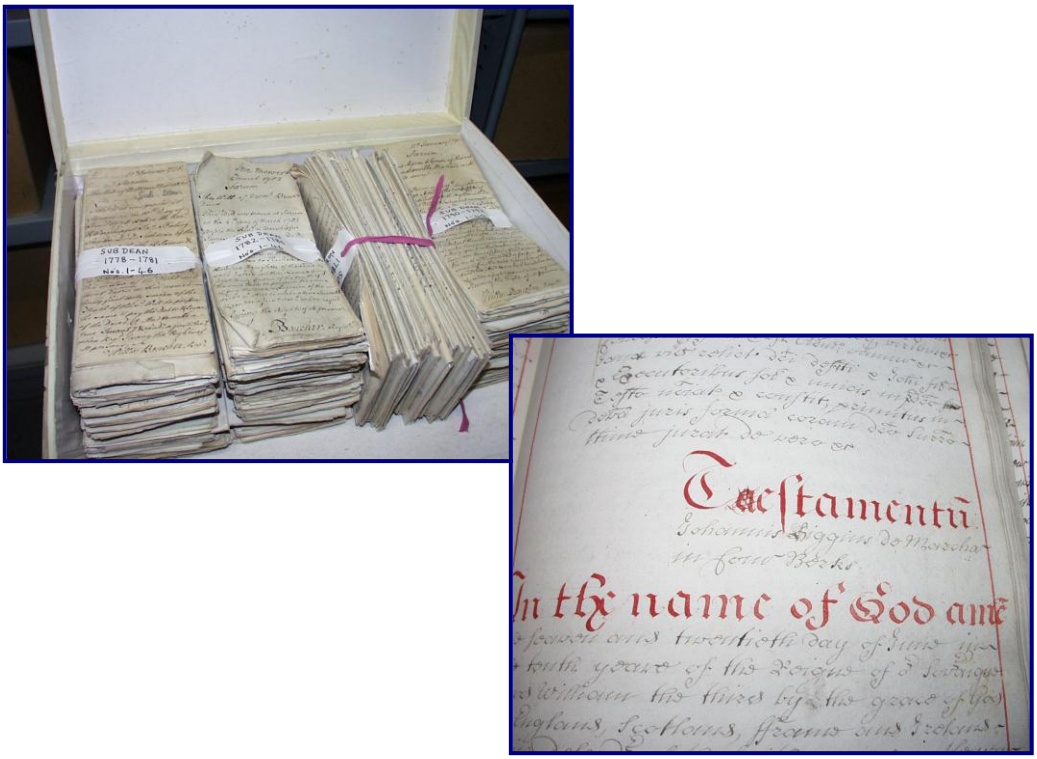


Executive Summary

The Wiltshire and Swindon Record Office has nearly ninety thousand wills in its care. These records are neither adequately catalogued nor secured against loss by facsimile microfilm copies. With support from the Heritage Lottery Fund the Record Office has begun to produce suitable finding aids for the material. Beginning with this feasibility study the Record Office is developing a strategy to ensure the that facsimiles to protect the collection against risk of loss or damage and to improve public access are created.

This feasibility study explores the different methodologies that can be used to assist the preservation and conservation of the collection and improve public access to it. The study aims to produce a strategy that will enable the Record Office to create digital facsimiles of the Wills in its care for access purposes and to also create preservation quality microfilms. The strategy aims to seek the most cost effective and time efficient approach to the problem and identifies ways to optimise the processes by drawing on the experience of other similar projects. This report provides a set of guidelines and recommendations to ensure the best use of the resources available for to provide the most robust preservation strategy and to ensure that future access to the Wills as an information resource can be flexible, both local and remote, and sustainable.

The feasibility report examines the issues associated with creating preservation and access copies of the wills in ten sections. Each section ends with a brief conclusion and set of recommendations.

- Section 1 examines the background to the Wiltshire Wills Project and this feasibility study. It describes the methodology that underpins the study and the way the project was conducted;
- Section 2 provides an overview of the collection of Wills and describes the collection as a whole and the environment in which it is held, its general condition, and the physical characteristics of the Wills;
- Section 3 considers four options for copying the collection:
    - microfilming only,
    - digitisation from microfilm,
    - simultaneous digitisation and microfilms,
    - and digitisation with computer output to microfilm.

  It also considers whether or not the work should be done in-house or outsourced;
- Section 4 examines the technologies that might be used to convert wills into digital form;

- Section 5 considers the possibilities of establishing a digitisation facility within the Record Office to ensure that the work is done to a consistent standard and in a secure environment;
- Section 6 considers the costs of support and maintenance of the system and services over the next five year period;
- Section 7 describes the meeting with users and the evaluation studies that were conducted. These examined the skills of users, their expectations from print facsimiles, and their expectations from online (whether local or remote) facsimiles of the collection;
- Section 8 recommends the standards and policies that the project should put in place to ensure that the quality of the digital facsimiles (e.g. resolutions, bitdepth) and the microfilm copies is acceptable. It looks at the preservation and administrative metadata that should be attached to the digital objects and the quality assurance procedures that should be put in place to manage output from the Project;
- Section 9 sets out an indication of the technical infrastructure and end-user delivery methods that would provide a suitable platform for online use of the Wills both within the Record Office itself and remotely.

- In the final section the conclusions and recommendations of the report are summarised.

The report has four appendices:

1. the objectives and aims of the feasibility study;
2. the questionnaire for the Print Facsimile Evaluation Survey;
3. the questionnaire for the Digital Facsimile Evaluation Survey; and
4. a job description for the digitisation post.

The feasibility study draws a number of conclusions and makes a series of recommendations. It concludes that

- for preservation purposes microfilm offers record offices the size of the Wiltshire and Swindon one the most secure and low risk approach to creating a security copy of its collection;
- for access purposes digital images provide the greatest flexibility in terms output and use;
- that the technology to digitise first and then output to microfilm offers the Record Office the most robust and balanced approach to copying and providing access to its collection;
- users of the digital versions of the Wills raise none of the objections to using digital copies that they do about using microfilm/fiche copies;
- users of the collection have the skills to use digital facsimiles of the Wills and are willing to use the material on-screen. Indeed they would appear to be excited by the possibilities

(e.g. zoom facilities which allow them to expand segments of the image to enlarge details);

- once the digital facsimiles are created it would be possible to restrict use of the Wills themselves to extreme cases;
- that users are willing to pay for good quality laser prints of the Wills and that these copies can be 300 dpi 8-bit greyscale copies;
- the costs of undertaking digitisation and microfilming and creating a suitable interface for the end-users for the system will exceed the available resources;
- the Record Office should take advantage of the project to develop an in-house facility to undertake the digitisation of the Wills;
- copies of media containing digital facsimiles Wills should be stored off-site;
- the online storage system should be simple and that the Record Office should not at present expect to be able to store the highest resolution images online, but that these should be stored on CDs or DVDs and loaded in response to user requests if they found the low resolution images insufficient; and,
- improved access to the collection would bring major conservation and educational benefits which would outweigh the costs.

These conclusions led us to make 33 recommendations that could underpin future work. Following a review of the Wills in the care of the Wiltshire and Swindon Record Office we recommend that:

1. the Wiltshire Wills Project does not go to tender for any of the work proposed in these recommendations other than the computer-output to microfilm (COM);

2. all the wills are digitised at 600 dpi at both 24-bit colour and 8-bit greyscale;

3. the 24-bit colour TIFF images are retained for preservation purposes;

4. the project adopt JPEG standards for the creation of images for delivery to the general public;

5. the images be made available to users in the Wiltshire and Swindon Record Office (a at 300 dpi colour and to remote users at 100 dpi greyscale;

6. the Project use a web-based front-end to provide users with access to the digital images;

7. the Project create preservation quality microfilms of the Wills from the TIFF 8-bit greyscale digital images using e-beam technology. This process uses the advanced Micrographics Electron Beam Recorders which create computer output to microfilm by recording directly the digital data to film using electron beam exposure;[1]

8. the e-beam conversion work be out-sourced and that the Heritage Lottery Fund be asked to permit the Record Office to proceed with a single source tender for this work;

9. the Project develop an in-house digitisation facility, which would increase security and enable an appropriate level of curatorial care and handling of the wills;

10. the Wiltshire Wills project set up a space within the Record Office suitable for the ~ digitising work to be done (see section 5.2);

11. a member of staff be employed to get the digitisation aspect of the project underway. The appointment of a digitisation technician should initially be for a two-year period (see section 5.3 & 9.2 for a sample job description);

12. the digitisation technician should report to the Wiltshire Wills Archivist with regard to work programme and operational procedures and to the Principal Archivist for line management;

13. the conservation of the wills should happen before any imaging is carried out as this will reduce the handling of the material and should improve the throughput;

14. the Project consider disbinding some of the bound volumes before digitisation to ensure that the work is done to the highest quality and to improve throughput;

15. the Project adopt a web-based front-end to display the images of the wills and the necessary metadata drawn from the CALM 2000-based finding aids;

16. the images used for printing copies of wills in response to requests from the general public be 300 dpi grayscale, which is a standard that the evaluation report indicated was suitable (see section 7);

17. a charging system be put in place for the provision of laser printed facsimiles of the Wills;

[1] See section 4.5 for full details. The cost of 600 dpi recording from uncompressed TIFF on archival silver microfilm at 24x reduction of 8 1/T' x 11 " original pages scanned 600 dpi including bar codes and blipping is 22 cents per frame. A setup charge applies for other formats.

18. given the high level of computer literacy among will users that the Wiltshire and Swindon Record Office only deliver the wills in digital form;

19. digital images created from microfilm will not be suitable for use by researchers;

20. wills be collated digitally before being output to microfilm rather than manually before scanning. This method allows for a greater flexibility in the imaging process and would make it possible to undertake an increasing percentage of imaging in response to user demand for wills;

21. the metadata for the digital images conform to at least the Research Library Group's preservation standards (see section 8);

22. the Project should reject all digital capture technologies except high-end digital cameras. This technology allows the Record Office to respond to variations in the quality and size of the materials;

23. the Project establish procedures and policies to ensure that the digitisation work is done to suitable standards and with adherence to appropriate Guidelines for Best Practice;

24. the Project should establish strategies that ensure the quality and consistency of the digital images;

25. the Record Office only store low resolution images (72dpi 8-bit greyscale) online and that the larger images be stored off-line;

26. where digital images are provided over the Internet or on fixed media (CD-Rs) that these images be watermarked to ensure that the copies which are redistributed can be identified as the property of the Wiltshire and Swindon Record Office;

27. offline storage be on DVD media which can be loaded in response to on-demand requests from users;

28. the project adopt non-proprietary and system independent index and file naming conventions that are cross-platform and application independent (see section 9 for a discussion of the system storage options) to enhance the ease of migrating the material to a new environment;

29. the project adopt a dual media solution for the storage of the security archival copies of images in high-resolution TIFF images, using both DVD and DAT tapes;

30. the security copy of all the digital images on DVD and DAT be stored off-site in suitable conditions (e.g. 30-40% relative humidity and 15ºC and following industry management standards (see section 8);

31. during an initial two month period the Project will establish standards and benchmarks for the digital process;

32. the Project plan its workflow on the assumption that the likely throughput for the project after the establishment of the standards and policies is likely 100 - 200 images per day. (The higher figure would be possible where there was no requirement to re-set or to re-calibrate the digital camera.)

33. the Wiltshire Wills Archivist visit the SCAN project at the National Archives of Scotland in June 2000 to observe a similar project in progress. It is anticipated that by this date the archivist will be able to see all stages in this project.

34. The Wiltshire Wills Project should establish a robust post-project strategy This strategy should allow the digitisation of the Wills to continue in response to requests from the public for copies of the wills, probably via an on-line version of the catalogue. The charges for supplying copies of the wills would assist in the funding for their digitisation. This strategy will enable the index of the wills to reach a wide audience without threatening them with serious physical damage.

35. That the Wiltshire Wills project decide in consultation with users and local supporters the priorities for digitisation. This will be subject to the final conclusions of the report.

Section 1: The background the Wiltshire Wills Project and the Feasibility study

1.1 Background to Wiltshire Wills

The Wiltshire Wills Project aims to catalogue, microfilm, digitise and repair, where necessary, the 90,000 wills and inventories which form the outstanding Salisbury Diocesan Probate collection.

The Project is funded for three years by a Heritage Lottery Fund grant with the matched funding being provided by local sources. Work has begun at the Wiltshire and Swindon Record Office. A Project Archivist has been appointed to catalogue the documents and is now investigating possible methodologies for proceeding with the microfilming and digitisation.

The Wiltshire Wills Project has three primary objectives. The first is to catalogue the documents, creating a public access database. The second is to produce preservation copies of the wills to archival standards, e.g. microfilms. The third is to produce high-quality digitised images of the documents and to make them available to the public at terminals in the Record Office in Trowbridge and also at Swindon Reference Library.

1.2 Feasibility Study

A number of issues requiring specialist investigation have emerged from the project. These should be researched with regard for the unique nature of the material involved. The feasibility study should explore the different possible methodologies using both research into other projects and pilot studies involving the wills themselves. The end result of the work should be the selection of a preferred methodology, presented in a written report to a standard format.

1.2.1 Backdrop

HATII responded to a Request for Proposals for a Feasibility and Pilot Study for the Wiltshire Wills Project. This call was issued by the Wiltshire Wills Project Management Team.

This work consists of two phases each of which have been costed independently.

- In Phase 1 a feasibility study and options appraisal will be delivered.

- Phase 2 will provide the technical documents necessary to produce a call for tender as well as the evaluation criteria that the project could use in evaluating the responses to the call for tender.

This report relates to Phase 1.

1.2.2 Purpose of the Study

The aim of the study is to explore the different methodologies that can be used to assist the preservation and conservation of the collection. It also aims to improve public access to the wills held by the Wiltshire and Swindon Record Office. The study aims to produce a strategy to make possible the digitisation or microfilming of the holdings of Wiltshire and Swindon Record Office for preservation purposes and their digitisation for access purposes. The strategy will aim to seek the most cost effective and time efficient approach to the problem and where possible identify ways to optimise the process that have been adopted by other projects or might be adopted by this one.

1.2.3 Method of approaching the problem

The project began with a literature review (including both online [i.e. web-based resources] and print resources, and where possible the grey-literature). Similar projects were contacted for practical assessment where necessary.

Seamus Ross and Ann Gow visited the Wiltshire and Swindon Record Office to:

- work with the project manager and curatorial staff to examine the kinds and nature of the material with which the project is working;
- examine workflow issues and consider whether indicative time and motion studies are necessary;
- assess current technological infrastructure to identify and prioritise the options for public access to the digital images and to whether the project will be able to maintain its own ICT infrastructure for access and distribution of the digital materials.

1.2.4 Delivery Schedule:

Phase 1 Final Deliverable:

This report:

- includes an appraisal of the three options examining time and motion, curatorial risks (e.g. increased danger to collection from multiple handling of the material), cost (including costs per page of each option, costs of producing preservation metadata, costs of integrating metadata and images), and project management implications of the three options.
- provides an indication as to whether the process of digitisation and microfilming should be out-sourced or conducted in-house. (If the Project adopts the latter approach it *may* not need to proceed to Phase 2.) Including an assessment of the various cost and management options.
- outlines options for protecting the rights of the Wiltshire and Swindon Record Office in their digital content will be outlined;
- details the process of digitisation of images and other materials (how will the process be managed, by whom etc) will be included This is important because it has an impact on the value of the digital images generated);
- identifies the metadata strategy that the project should adopt;
- defines the image formats that should be used for capture, access, and long-term storage of the digital assets;
- identifies the targets (e.g. scale, measurement and detail) that the project should use;
- appraises the access storage and preservation storage requirements (e.g. CD-R, DVD, DAT or DLT tape) for the digital files will be defined (e.g. what will be file sizes of the full image scans? Will these be retained in uncompressed format?)
- indicates the image management system and hardware requirements for handling the storage and delivery of the digital images. This will provide an assessment of in-house and outsourced options.
- describes the activities that the project will need to carryout to support quality assurance of the imaging aspects of the project and it will outline what tools and metrics the project should use to evaluate the quality of its digital images whether from the original or from microfilm and point the project to existing guidance for microfilming;
- explains where microfilming is recommended the study will identify changes to the preferred microfilming standard which could be adopted without loss of quality that would improve the chances of producing high-quality digital images from film;
- defines the file sizes which should be made available over the Net for different purposes and when online and offline delivery strategies should be adopted.
- indicates interface design that the project should adopt (this might include story board sketches of a proposed interface itself); and,
- indicates of the costs of running (including maintenance and support) the public access system during its first three years of operation.

2 Section 2: Overview of the collection in the Wiltshire Wills project

2.1 Visit and main purpose of visit

The visit to the Wiltshire and Swindon Record Office in Trowbridge took place from 9.30 am on Monday 6th December until 4.30pm on Wednesday 8th, both Seamus Ross and Ann Gow were on site. Meetings were arranged throughout the visit to ensure that all the areas of the project were covered.

2.1.1 Main Purpose of Visit

The main purpose of the visit was to examine 100 representative items from the collection. These represented extreme examples as well as typical records. Different content as well as different media was available. The archivist provided more extreme examples from the collection, e.g.

- Outsized material
- Stained material
- Large Bound volumes
- Faded materials
- Wide varieties of handwriting, typescript, etc
- Different media - different paper qualities
- Damaged materials

2.1.2 Set Meetings

There were a series of meetings arranged in advance:

- Meeting with Lucy Jefferis at 9.30 on 6th followed by a introductory tour of the Record Office, including the Collections, the Reading Rooms and other areas.
- Meeting with Lucy Jefferis and Tom Craig at 3.30 p.m. on 8th to conclude visit.

2.1.3 Formal Meetings to be arranged

These meetings were arranged with:

- Conservation staff to discuss methods of treatment of records, volumes, etc in the light of a digitisation programme and to discuss the profile for any conservation programme and future developments.
- The IT support staff (either in the Record office or attached to the County Council) to discuss the level of support required and available. This meeting discussed the existing profile of the IT infrastructure and the development plans.
- Typical and future users of the wills.

2.1.4 Documents & Materials

The following documents were requested:

- A copy of the original report.
- A profile of the existing staff and relevant experience and a projection of specialist staff required for programme. Informal meetings with staff occurred throughout the visit.
- Finding Aids - both hard copy and electronic resulting from the initial conversion programme.

2.1.5 Areas to Examine

- Storage areas: where the collection is stored
- Any possible areas identified for digitisation
- Other spaces in the Record Office

2.2 Description of collection - The Record Office

The Record Office exists to preserve the documents that record the history of Wiltshire and to make them available for research. These documents include letters, maps, registers, minute and account books and deeds. Modern records are held as well, to ensure that the present is documented for historians of the future.

2.3 The Records

There are many and varied records within the Record Office, but broad categories are these:

- **Official Records** include those of the County Council and its predecessor authorities, particularly Quarter Sessions, Boroughs, Urban and Rural District Councils and present day District and Parish Councils, Hospitals, Poor Law Unions, Water Boards, Police and Schools and Colleges.

- **Church Records** include the administrative and probate records of the Diocese of Salisbury, which covered Dorset and Berkshire for certain periods, the whole of Wiltshire and Berkshire and the parish of Uffculme in Devon; Church of England parish registers of baptism, marriage and burial and other parish records such as those of overseers of the poor, churchwardens and charities, and records of Nonconformist churches, for example Methodist, Baptist and Quaker.
- **Private records** include those of families and landed estates, solicitors, businesses, local clubs and societies.
- **Restrictions:** Certain kinds of judicial, medical and local government records are closed to public access for periods ranging from 30 to 100 years.

2.4 Description of the Wills

The most striking aspect of the wills is the variety and diversity of form. Each will can have one or more documents associated with it, e.g. inventories, etc. There is no set number of leafs/ pages for each will and there is no accurate estimation for this figure. Each leaf may be written on both or one side or on folds of paper. This raises serious concerns for the imaging process as costs will fluctuate depending on the amount of material to be photographed and the time included in handling the materials. The visit allowed the study group team to view some of the more unusual wills, e.g. rolls of vellum, pages held together by silver pins, pages sealed by silk tape and wax. Many of the wills are in extremely delicate state of conservation, with water and damp damage. As most of the wills have been folded and stored in cramped boxes, the folds on the leafs have caused tearing in the centre of many of the wills as well as obscuring much of the texts.

Those wills bound in registers can vary from tightly bound registers that have serious issues for gutter shadow, to bundles of wills, very loosely bound and damaged at the edges.

These features of the wills pose a variety of problems for imaging and for managing. The

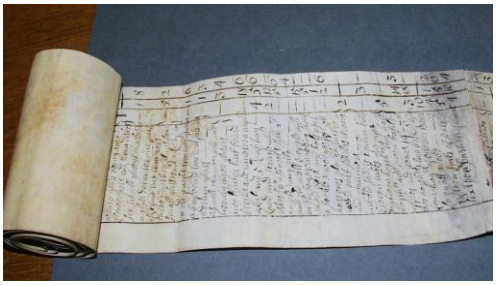


Fig 1. Inventory on Roll of Vellum, 252cm x 12.5cm

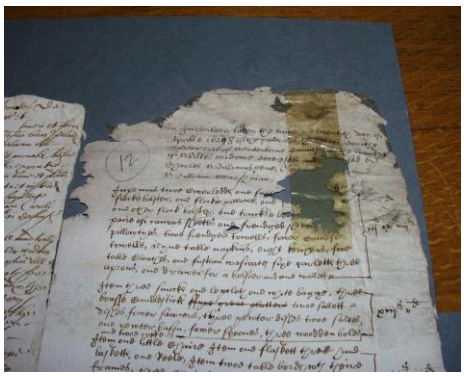


Fig. 2: Damaged will with unsatisfactory mending

images that follow illustrate some of these features in detail.

2.5 Storage of the Wills

The collection of wills is held in the Wiltshire and Swindon Record office in the main storage area in two separate aisles, taking up approximately 10 shelving areas. The wills are stored in a variety of containers reflecting the changes of approaches to archives throughout the years. As the wills are newly catalogued as part of the project, they are refolded and where necessary, have conservation work done and then placed in acid free boxes to ensure their longevity.

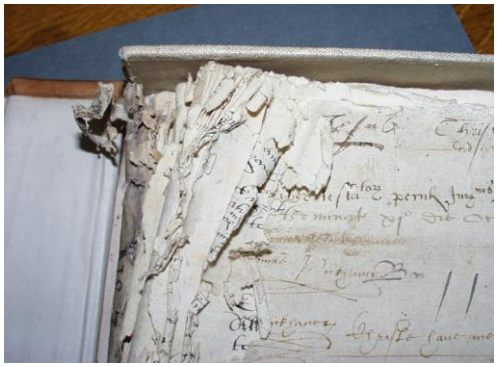


Fig 3: A wills Register with damaged edges

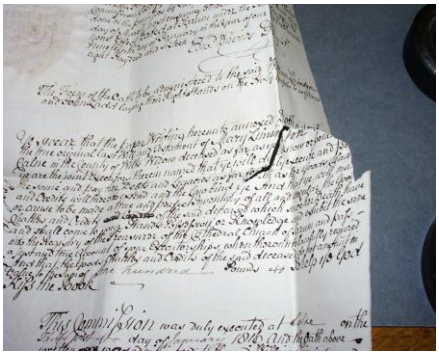


Fig 4: Will with damage on the folds

Examples of containers for the wills:

- Acid free boxes.
- Box files
- Locked cases
- Wooden boxes
- Unbound books
- Previously bound registers

Fig 5. Various Containers on shelving

Fig 6. Shelving

These storage methods reflect the variety of sizes and shapes of the wills. The wills come in a range of sizes, materials, parchment, paper, vellum, etc. The number of can vary from 1 - 7 or more.
Within these shelves and containers, the wills are stored in a range of methods:

- Registers
- Tied Bundles
- Loose in containers

Fig 7. 18C wills loose in container

Fig 8. Registers of Wills

Fig 9: 19C wills in bundle

3 Section 3: The four options for copying the collection

The original proposal for the Wiltshire Wills project was to "produce preservation microfilm copies of the wills to archival standards" and " is to produce high-quality digitised images of the documents and to make them available to the public". The study team had to examine four possible methods that could be used to achieve this goal. The technologies were looked at as separate possibilities and as simultaneous operations. While exploring the technology options, the variation and diversity of the wills was considered as well as the conservation and management issues.

3.1 Microfilming - previous microfilm

Microfilm is the accepted method for long term preservation of records such as the Wiltshire Wills. Microfilm offers acceptable levels of quality, media longevity, little machine dependency, and the means for producing additional copies with acceptable informational loss. Archives and Libraries have used and are using microfilm as the main preservation medium for records and other documents. The medium is recognised, with standards for imaging to ensure flexible and accessible material for the users. When the microfilm is processed and stored to the agreed standards, it is very long lasting and simple, easy and relatively inexpensive to store. Duplicates can be made of the film, if signs of deterioration show. As many copies as required can be made to allow a large number of users greater access. The standards referred to are from the Research Library Group Preservation Microfilming Handbook, edited by Nancy Elkington (RLG, 1992). These apply to black and white microfilming. [2]

This section does not seek to be an exhaustive tract on microfilming but highlights the areas of the process that have direct bearing on the wills and their unique content and format.

There are three main products from the microfilming process:

- Master Negative: this is the film in the camera when the material to be preserved is actually photographed. This is the main archival medium and must not be used except to create the printing negative.
- Printing Negative: This is direct copy of the master negative and is used to generate positive copies.
- Positive Copy: This is the film the user reads in the archive or library. It is from this film that any further access copies are made, e.g. for individual access.

[2] Colour microfilms are not preservation quality because the colour dyes are not sufficiently stable.

There has been two previous attempts to microfilm the wills, the films were discovered by the Wills Archivist. There was no associated metadata to explain the technical process that had occurred during the photography stage, and the films are of questionable quality.

The study team have evaluated the films and have found them to be:

- Poor
- No metadata
- The associated documentation is very limited, incomplete and very difficult to check
- No idea if Master negative or Printing negative are suitably stored.

While we were concerned about their preservation quality we felt that the Archives might consider acquiring a full set of the films and evaluating them for their against the originals. If it transpired that the set were legible and sufficient metadata could be added to the films (e.g. creation of a detailed bibliographic record for the films) then the Project could adopt the digitisation route alone.

3.2 Creating new microfilm versions of the wills

Many of the steps in this process can be applied to the digitisation process as well. However, the collation of the material is more rigid in structure for microfilming than the more flexible digitisation approach.

3.2.1 The Microfilming Process

Roll film is available with several different width options, 16, 35, 70, and 105mm with the most predominant sizes of 16 and 35. Once processed, the film is stored in cartridges or cassettes which ease in loading film into the reader. The arrangement of the image can be done in several ways. The most common are:

- Comic format (in which pages or frames are positioned in comic strip style, with one long row of images parallel to the edges of the film)
- Cine format (in which pages or frames form one long column of images, perpendicular to the edges of the film).

In addition, frames may be simplex, with one page per frame. or duo, duplex, or duo-duplex, with two or more pages per frame.

The reduction ratio of a microform is the ratio which indicates the number of times the original image has been reduced through the filming process.

Low- up to l5x
Medium- up to 30x
High- up to 60x
Very high- up to 90x
Ultra high- 90x and higher

The magnification ratio is the opposite of a reduction ratio. It is normally used to indicate the power of a lens in a microreade or reader. Resolution is defined as the sharpness of a microfilm image. Quality and degree of resolution can be determined by checking a Resolution Test Chart, on the first frame of a microfilm. Contrast is the tonal difference (high and low brightness) between the light and dark areas in a microimage.

Roll film is generally 100 feet in length and approximately 5 millimetres thick. The first and last few inches are blank (a "leader"), although they may contain bibliographic data. Microfilm is usually wound on a reel, but may be placed in cartridges or cassettes for ease of use, file security, and protection.
Microforms must be compatible with the existing microforms collection and with available equipment. Reduction and magnification ratios, type of microformat, storage requirements. and standards which were followed in the manufacturing process should all be considered. The type of film stock- silver halide, diazo. or vesicular- should be selected according to the intended uses of the microform. Silver halide film has been determined by the American National Standards Institute to have an indefinite shelf life if properly cared for and stored.

3.2.2 The main steps in pre-filming process:

a. Collation/count sheets
b. Repairs
c. Orientation and reduction ratio
d. Preparing metadata
e. Final preparation

3.2.3 Collation:

The materials to be photographed must be in the correct sequence to allow the microfilm to be accessed correctly. Each will, or part of a will, would have to be collated before photography. This method is extremely expensive in time and also does not permit a more staggered approach to the filming of the materials.

a. Ensure materials are in the correct sequence.

b. Disbind any materials that cannot be photographed without loosing information, e.g. gutter shadow in bound registers, corners of wills bound by silk and wax.
c. Any areas that may not photograph well due to faint handwriting, discolouring of the paper, etc must be noted.
d. Any damage that will result in loss of information should be noted, e.g. damp damage, damage from folds, etc
e. Remove additional materials, e.g. silver pins, staples, etc
f. Any unusual page layouts need to be brought to the photographers attention. The wills are inherently "unusual" and almost all leafs vary in size from the previous leaf. This means that the camera would have to be continuously adjusted at each shot to allow for the variety of page sizes and orientation. While this will not change for the digitisation filming, the order of the wills is not so rigid and would allow more flexible processing of the wills.

3.2.4 Repairs and Conservation

The material to be filmed should be conserved and repaired before filming to avoid further damage and to ensure the best image. The Wiltshire Wills project has started the process of conservation based on the cataloguing that is on-going.

3.2.5 Orientation and reduction ratio

The orientation of the page will vary widely in each will as well as from will to will. The archivist must always consult the filmer for advice on orientation and reduction ratio. The reduction ration is decided by the size of the original object, i.e. the larger the object the greater the reduction ratio required to ensure the whole area is captured.

3.2.6 Preparing metadata

To ensure long-term usability of microfilm, correct and thorough metadata must accompany every film, generally by capturing target sheets at the start of each roll of film that have technical and content information for the user and future archivist. The lack of metadata with the older microfilm renders them almost unusable. This metadata should be related to the catalogue using the CALM 2000 software package.

3.2.7 Final Preparation

The materials should be reviewed and the instructions to the filmer made clear. The materials must be in the correct order with attached metadata.

Microfilming the wills has the following main issues of concern for the study group:

- The materials must be collated accurately before filming to ensure the correct sequence on the film
- Once started, this order cannot be altered to allow a more flexible approach, e.g. to film all the wills from one court or particularly popular wills.
- This order then relies on the conservation team. If a series of wills requires time-consuming restoration, the filming process has to stop until the wills have been filmed in the correct order to ensure reel to reel co-ordination.
- The wills are of varying size and shapes and require changes of orientation and reduction ratio. The set order will result in many camera-head alterations during one filming session and thus be extremely costly.

Recommendation wills be collated digitally before being output to microfilm rather than manually before scanning. This method allows for a greater flexibility in the imaging process and would make it possible to undertake an increasing percentage of imaging in response to user demand for wills

3.2.8 Microfilm Costs - Wright State University's Department of Special Collections and Archives [3]

Pricing information:
Microfilming is billed per exposure, or frame. This usually means "per page."

> 16mm. rolls: $.09 per frame. 16mm. microfiche: $.16 per frame. 35mm. rolls: $.25 per frame.

Price includes

> Preparation of the documents for filming. Filming the documents according to archival standards. Return delivery for records outsourced. One copy of the film for the customer to use for regular access. Additional use copies available for $25.00 per roll or $2.00 per sheet of microfiche. Permanent storage of the original negatives in the WSU Archives. Permanent opportunity for access and duplication.

Return of original documents or disposal by the appropriate method, as preferred by the customer.
Technical Standards:
The following technical standards for the camera negatives are maintained:

[3] http://www.libraries.wright.edu/staff/dunbar/arch/micro.htm

Background density between .80 and 1.30, with no more than .20 variation throughout. Resolution: Minimum of 100 lines/mm. Chemical Residual Hypo not to exceed 1.4 micrograms of thiosulfate/ sq. cm., stability monitored weekly. Splicing, where required, is done by ultrasound; no tapes or adhesives are ever used.

3.3 Digitisation

The possibilities of digitisation seem endless to the archivist or librarian and offer a large range of options for creation, storage and manipulation of rare, valuable and inaccessible materials. These possibilities are indeed true but any digital project requires an understanding of the issues involved and the possible results and implications for the materials and project. The wills would be photographed or scanned digitally at a resolution that ensures the highest quality digital image and the greatest capture of detail. Each digital image is a separate object from the next and can be accessed in any order required by the end user. The wills would be subject to a similar light source as in microfilming and would require the same level of expert handling to avoid any further damage.

3.3.1 Conserve

As with microfilming, much of the digitisation process is in the preparation of the material beforehand and the creation of a effective set of metadata. The material must be conserved and repairs made before being photographed by the digital camera. As before, this ensures a limit to the damage to the wills and also ensures the best image for access and preservation.

3.3.2 Catalogue

The materials to be digitised should ideally be catalogued before the filming process to allow for the creation of metadata. This is explained more fully in a following section. The catalogue used by the archivist is CALM 2000 and the reference number that is assigned to each can be used in the metadata for the digitisation process. However, the naming convention for the digitisation process can be adapted to allow for the reference number to be added after digitisation. This allows digitisation to be separate from cataloguing. This flexible process might be useful if one set of highly popular wills were digitised out of cataloguing sequence.

3.3.3 Metadata

For a full explanation of the metadata schemes and recommendations, see section 8; Standards and Policies.

3.3.4 Digitisation Features

The digitisation of the wills allows for a preservation version of a will and as many subsequent copies as required for user access and further research. Unlike microfilm, there is no real generation issue and copies can be made easily and efficiently. This ease can enable copies being made without authorisation and thus encryption and watermarking are to be considered carefully. The archive digital version will be high resolution, full colour and with no compression. This allows smaller, more accessible files to be created from this archive version at any later date. Digital images can be viewed and manipulated to allow detailed research. Digital imaging facilitates a flexible approach to the dissemination of the wills for the users and researchers. It is to be remembered that these are digital images and not searchable text, such as this document.

3.3.5 Naming Conventions

The naming convention for the digitisation process is fundamental and allows the connection of the digital image and the CALM catalogue, enabling users to search the catalogue and view the image in one action.

3.4 Simultaneous Digitisation and Microfilm

The third option for the Wiltshire Wills project is to simultaneously digitise and microfilm the materials with two separate cameras. This would enable the wills to be in both formats and to reach the project target.
This is very expensive process, as it requires the expertise of a microfilmer and a digital photographer. Each will varies in size and shape and the adjustments made to each shot would vary for the microfilm camera and thus for the digital camera.

The order of filming is proscribed by the microfilm process and thus does not allow the flexible approach to sequence that digitisation has.

3.5 Digitisation and Output to Microfilm (COM)

A relatively recent technological innovation allows the fourth option for filming the wills, that of digitising the wills and then using e-beam technology to create preservation standard microfilm from the digital images.

The process enables the final goal of both digital images for access and research as well as microfilm of the wills for long term preservation and conservation. The process of outputting digital images to microfilm does not require simultaneous processing, the digital images can be converted at any time, in the future or immediately after digitisation.

E-beam technology or Electronic Beam Recorder is a technology developed over 20 years ago for aerial and satellite photography, for cartography and geophysical data. It is a cost effective way of producing high quality microfilm images for archival purposes.

From the I-Graph web page[4]:

"What is *e-beam* film?
Electron beam film is a fine grain, silver halide film which is exposed directly with a computer controlled Electronic Beam Recorder (EBR) and processed into archival microimages using conventional photographic chemistry. The photographic-like quality of the images recorded by direct exposure of a 4 micron diameter electron beam has a much sharper edge acuity than microfilm images recorded with conventional COM recorders, which use either cathode ray tubes or laser beams. The direct electron exposure process does not suffer from spot degradation caused by phosphor granularity and lens losses in a CRT recorder or the light scattering and reflectance loss found in a laser beam recorder. This recording process also provides *256* level gray scale to record continuous tone microimages

Electron beam image recording offers a cost effective methodology because it provides much higher volume production which lowers the per unit cost. The direct exposure energy of a 20,000 volts electron beam allows a 5 to 10 times higher recording rate than conventional COM recorders. The electron beam addresses the full image frame or fiche format. As a result, this eliminates any step-and-repeat or movement of the film during the recording process and the need to reformat or process the input data prior to recording."

The process has been used by many geophysical projects, cartographers, etc but has recently been used by projects in the culture and heritage sector, most notably the Cornell Brittle Books project [5]and the Library of Congress. The tests carried out by these projects showed

[4] http://www.igraph.com/rc_ebeamfilm.htm
[5] See http://www.igraph.com/rc_cornl_wp.htm for white paper on this project.

that using e-beam technology to create microfilm of archival standard was possible and also cost effective and efficient. The digital data has to be supplied in CD-ROM, Exabyte Tape, Optical Disk or DAT Tape.

Cost to 35 mm Microfilm from Grayscale images[6]

35mm microfilm

Images	*Price/Image (cents)*		
Resolution	300 dpi	400 dpi	600 dpi
100% Inspection	17	20	25
Limited Inspection	15	18	22

The inspection guarantees that there are no dust scratches or environmental damage to the microfilms as well as for missing data or content.

While this process can be carried out at any time during the Wiltshire Wills project, the microfilms must contain the data in an order that enables easy access and retrieval for future users of the microfilm. It is likely that this process would be carried out once any digitisation process was well under way. However, as time progresses, the cost is likely to reduce and thus make it more efficient an option.

Recommendation: the Project create preservation quality microfilms of the Wills from the TIFF 8-bit greyscale digital images using e-beam technology. This process uses the advanced Micrographics Electron Beam Recorders which create computer output to microfilm by recording directly the digital data to film using electron beam exposure;

Recommendation the e-beam conversion work be out-sourced and that the Heritage Lottery Fund be asked to permit the Record Office to proceed with a single source tender for this work;

3.6 sourcing / in-house

The four methods described above are the options available for filming the wills. To be considered is the possibility of in-house processing or outsourcing.

[6] http://www.igraph.com/rc_price_gray.htm

3.6.1 Outsourcing:

A suitable company that understands the content of the wills would have to be identified. The wills would have to be collated each time a batch was sent for digitisation and clear instructions presented to the company. The movement of the wills from the secure environment of the record office always carries a risk. The further the wills have to travel increases this risk.
The archivist or other identified staff member would have to carry-out detailed inspection of the resulting digital images to ensure the content was correct and that there was no data damage or mistakes in the naming system and metadata.

The main hurdle to outsourcing is the cost, it is an expensive process and once started with a company, becomes difficult to change. There is no expensive equipment to purchase or space to provide within the record office and no staff member to employ.

The main risks associated with outsourcing are:

- Damage to original materials either through transport or handling
- Materials' collation disruption
- Poor quality assurance
- Lack of on-site supervision by archivist
- Additional cost to ensure the safety of the materials.

3.6.2 In-house

In-house processing requires three main items:

- A digital camera and associated equipment
- A trained digital camera operator
- A committed space for the process

Purchasing a digital camera and one trained staff member will enable the project to be carried out in-house and has associated advantages not immediately apparent:

Transferable skills: the record office staff will be able to observe and use the camera after training from the camera operator. These skills are extremely useful to archivist and librarians in this digital age and can only enhance the skills base of the record office as a whole.

Additional use of equipment: The camera can be used to digitise other materials when the wills digitisation is not in progress, e.g. after office hours, during vacations, etc. If the skills of the record office staff are at the required level, then this can be done without the camera operator in place, thus giving much greater flexibility from the camera and equipment.

The main advantage to in-housing is that the wills need never leave the record office site which will ensure their safety and continued conservation.

Recommendation: the Wiltshire Wills Project does not go to tender for any of the work proposed in these recommendations other than the computer-output to microfilm (COM);

Recommendation: the 24-bit colour TIFF images are retained for preservation purposes;

4 Section 4: The Possible Technologies to convert the Wills to digital form

4.1 Technology of Digitisation

Digitisation refers to the process of translating a piece of information such as a book, sound recording, picture or video, into *bits*. Bits are the fundamental units of information in a computer system. Turning information into these *binary digits* is called digitisation. This digitisation process can be accomplished through a variety of existing technologies.

4.2 Digitisation Chain

The digitisation chain is the whole digitisation process described by five main links. Each link must be complete before the next to ensure a high quality digital resource that meets project aims and objectives.

The main components:

- the people… (staff, advisors, users, etc.)
- the collection(s)
- hardware and software
- policies and procedures
- standards

Link 1: Benchmarking

Examine physical and other characteristics of document / quality benchmarking

Link 2: Scanning

- Capture the document
- Format the file
- Create metadata
- Check for quality

Link 3: File Management

- Compression
- Backup and Storage
- Make derivatives for access
- Error detection and correction
- Migration

Link 4: Access and Networking

- Servers
- Communication Protocols
- Authorisation and Security
- Possibility for expansion

Link 5: Display and Printing

- Decompression
- Integration with Image Browser
- Magnification
- Colour calibration
- User interface

- Decompression
- Interpretation to printed page
- Scaling

Recommendation: the Project consider disbinding some of the bound volumes before digitisation to ensure that the work is done to the highest quality and to improve throughput;

4.3 Flatbed Scanner

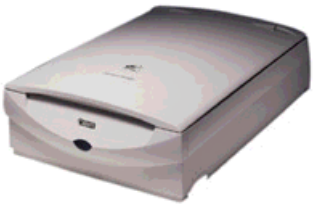
The scanning process uses hardware similar to photocopiers (scanners) to take digital pictures of objects. Scanners can be simple desktop machines or very large and complex systems that process thousands of documents. The physical form of the object can have a great impact on the type of scanning equipment that can be used. Many of the current scanning systems have been designed for business applications where documents are often single sheets or within a

small range of sizes which makes them amenable for automatic scanning. The fragility, odd sizes, and bound volumes of archive and library materials pose greater difficulties for scanning. As discussed above, the Wiltshire Wills have many of these problems.

Flatbed scanners are ideal for single leaf, regular sized and shaped documents. Flatbed scanners have a maximum imaging area, the most common is usually from 8.5 x 11 to A4, however, flatbed scanners with larger imaging areas are available and are used often by cartographers imaging large maps, etc.

Example of a flatbed scanner[7]

Features • 1200 x 1200dpi optical resolution using VAROS technology • 36-bit colour depth for rich vivid scans • SCSI interface for fast scanning performance



4.3.1 Scanner Technology

There are three common types of scanning technology.

- charge-coupled devices (CCDs)[8]
- CMOS sensors (Complementary Metal Oxide Semiconductor)[9]
- photomultiplier tubes (PMTs) - For Drum Scanners, not suitable for the Wiltshire Wills

The main issue with using a flatbed scanner is the irregular shape and size of the wills, while some could be scanned on a flatbed scanner, most would not fit and thus this technology is not the recommended one for the Wiltshire Wills.

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[7] The CanoScan FB1200S: http://www.canon-europa.com/products/products.html

[8] CCD: solid-state electronic element composed of multiple tiny sensors which register an analogue electrical charge proportional to the intensity of light it receives.
Light reflects off or through the image onto a set of light sensitive diodes.
In flatbed scanners this tends to be a CCD (charged-coupled device) array.
When the CCD arrays are exposed to light, they convert the data into a digital value.

[9] CMOS; Similar to traditional CCDs
Manufactured using same techniques as CMOS memory chips
Mass production techniques result in lower cost
Usually have A/D converter as part of the device rather than as a discrete unit
Introduced to low cost digital cameras in 1996
Lower quality than traditional CCDs but improving all the time

4.4 Book Scanner [10]

A new product from Minolta, has features that reflect the needs of the Wiltshire Wills. The PS 7000 book scanner is specifically designed to scan books, with an integrated book cradle to enable the filming of a book to a high standard of quality:

" The PS 7000 system offers the most advanced features designed for the reproduction of bound materials, including face up scanning, protection of spines, automatic curve correction, shadow erasing, enlargement and reduction, easy handling of oversized materials and simple, fast efficient operation"[11]

Purchase Price = £12,447.00

This scanner has many features that are attractive for the Wiltshire Wills project but ultimately is not as flexible as a digital camera.

4.5 Three colour shot Cameras

One type of technology that digital cameras use is to employ three image sensors instead of one, one for each of the colours red, green, and blue; or possibly for final printing, cyan, yellow, and magenta. Another approach is to use a single image sensor but make three passes for each image with a different colour filter over the image sensor for each pass. Both approaches call for long exposure times and subjects that don't move or even blink. The three separately captured image files can then be combined for a full colour image or kept separate for printing purposes.

The technology works by measuring each colour separately and not at the same time, which means that there is a possibility of changes in value between each measurement. This could be the lighting, or physical movement in the floor, or even camera movement. Generally, three shot cameras work best with non-animate objects that will not change between the three shots. The Wiltshire Wills are of this type and three shot photography is suitable for the Wills.

[10] http://www.minoltaeurope.com/minolta/products/scanning/ps7000.html
[11] Sales literature: Bill Watson, Minolta (UK) Ltd

4.5.1 Example of a Single Shot Camera

Leaf Volare™[12]

"3-shot color images through RGB filters; 1-shot black and white. RGB filters provide best possible color quality from a digital back, exposing each pixel to full color information"

CCD:	• 2048x3072 pixels, 24x36mm • Actively cooled • Hardware anti-blooming • Leaf VHtwist™ CCD rotation
Exposure:	• 3 shot color, 1 shot black and white • Up to 32 second exposures • Live video focusing at 4 fps • ISO 200 equivalent for b/w • ISO 25 equivalent for color
Dynamic Range:	• Greater than 12 f/stops • 14 bits per pixel per color (16,384 grey levels)
Live Video Preview:	• Full frame and full resolution modes • Contrast meter • Leaf Digital Layout™ • Auto & manual brightness control • Grid lines for image alignment • Tilt and swing focus axes (Sinar only)
Available Camera Body Adapters:	• Hasselblad 553 ELX, 500 EL • Mamiya RZ 67 • Fuji GX 680 • Sinarcam, Sinarcam/p2
Lighting:	Compatible with Strobe, Tungsten,HMI and Daylight
Computer Requirements:	• Apple Power Macintosh 8500 or higher/Pentium II 233 or higher • System 8.1/Windows NT 4.0 or higher • Unoccupied PCI slot • 128 MB RAM • Monitor and video card for minimum 1024x768 resolution at 24 bits per pixel
File Size:	• 36 megabytes (42 bit Leaf HDR, color) • 18 megabytes (24 bit, color)

[12] http://www.sinarbron.com/mainframe.htm

	• 6 megabytes (8 bit black and white) • All files 2048x3072 pixels
Dimensions:	8"w x 5"h x 4"d
Weight:	2.8 lb
Power Supply	110-220 vAC, 50-60 hz, autoswitching
Agency / Safety Approvals:	FCC class A, DOC class A, CE, UL, CSA, TUV

4.6 Single Shot Cameras

Single shot digital cameras capture the image in one shot using technology to calculate the value of the RGB colours in the image. There is one pass of the camera lens and all measurements of all colours, RGB or CMYK are taken. The Phase One camera is the leader in this technology:

"Based on an array CCD technology, the new LightPhase features a 2,000 x 3,000 pixel resolution. Generating RGB file sizes of 18MB in 8 bits per colour and 36MB in 16 bits, the LightPhase provides more than enough information to print high quality images at sizes over A4/8.5" x 11". The resolving power of the new Phase One LightPhase is so good even outdated, inexpensive strobe lighting is sufficient for crisp, beautiful images. Additionally, the 48 bit internal data path with 14 bit analogue to digital converter gives perfect details in shadow and highlight areas with a better contrast range than is possible with film.
The flexible light requirement of the LightPhase enables an equivalent ISO of 50 and exposure times up to 2 seconds. The camera system's extreme light sensitivity offers an incredible dynamic range of 11 f-stops. Perfectly designed for strobes as well as continuous lighting including daylight, tungsten, fluorescent, and HMI, this unique imaging device clearly sets a new standard in high quality, professional level single shot digital imagery.
The revolutionary LightPhase supports Hasselblad's full line of superior photographic equipment including all mechanical and electronic models - even the new 555ELD. The rectangular 24mm x 36mm image capture area with rotation feature allows the camera to be used in both portrait and landscape mode. Because images are typically cropped, the rectangular CCD of the new LightPhase allows the final captured file to be technically 50% larger and effectively 100% larger than any other existing digital solution. This feature allows photographers to make compositions of rectangular images before shooting, enabling the use of maximum resolution offered by the camera"[13]

[13] Phase One Press Release: http://www.phaseone.com/brochures/lightphase/lightpr.html

Recommendation: the Project should reject all digital capture technologies except high-end digital cameras. This technology allows the Record Office to respond to variations in the quality and size of the materials;

Recommendation: the Project plan its workflow on the assumption that the likely throughput for the project after the establishment of the standards and policies is likely 100 - 200 images per day. (The higher figure would be possible where there was no requirement to re-set or to re-calibrate the digital camera.)

4.7 Lighting

When using photography, whether digital or traditional 35mm film, the lighting conditions will affect the quality of the colours in the image and thus the final image. Lighting affects how we see colour, sunlight will make the same colour appear different than when viewed under fluorescent lights.

It is important to maintain the best possible lighting conditions when digitising the wills and to ensure that the lighting remains at the same setting throughout the digitisation process. This can be established by benchmarking the lighting levels at the start of the day and ensuring that there is no change from the previous day. This has an effect on the space, which should have no natural light source and rely on lights of a photographic standard when filming and any other light source must not be apparent when filming, e.g. overhead lighting.

5 Section 5: Establishing a digital facility within the Record Office

5.1 Why

As has established in section 3, the Wiltshire Wills project is recommended to carry out the work on the project in-house top ensure appropriate levels of curatorial care. For this in-house process, a suitable space should be identified and adapted to function as a long -term digitisation centre within the Record office that can be used for other projects as well as the primary role for the Wiltshire Wills.

5.2 The Space

The Record Office does not have a great deal of space available to use as a digital centre but the Project Archivist has identified a space that may be feasible to be the digitisation centre. This room is directly accessible from the Conservators room as well as directly into the

strong room, thus enabling the wills to be digitised without having to leave the floor that they are stored on. Additionally, the Project Archivist's room is very close by which will permit more efficient management and supervision of the whole imaging process from compilation to returning the wills to the boxes and shelves.

- The room measures 10' x 14' 8"
- It has two doors (with small glass panels) on adjacent walls, one into the strong-rooms and one into the conservation room. It is very close to the Project Archivist's room.
- It has one large window with a blind on one of the shorter walls.
- There are two water pipes at ceiling level by the window.
- The floor is grey-tiled.
- There is a 6' double strip light.
- There are two power points.
- There is a dust extraction unit for cleaning work on the window wall. At its most prominent point it extends into the room by 20 inches.

To function as a digitisation centre, the room should:

1. Have any extraneous material removed.
2. Have the window blocked over to ensure no interference from natural light
3. Have the glass panels blocked over to ensure no interference from adjoining room lighting
4. Have one door blocked to ensure that only one entrance is available, thus reducing possible interruption during the filming process
5. Have shelving and surfaces built to accommodate the digital camera, the camera stand, and the cradle which will hold the wills as they are photographed.
6. The camera area itself should have a small curtain area that can be drawn to obscure any interruption from changing environment lights.
7. Have the electricity supply overhauled to ensure that there is no fault that might cause fire or power surges. Increase the number of power points.
8. Have atmosphere controls fitted to ensure appropriate curatorial standard for the wills.
9. Have a control entry on the door to ensure that no-one can enter while the digital photography is in progress.

Recommendation: the Project develop an in-house digitisation facility, which would increase security and enable an appropriate level of curatorial care and handling of the wills;

Recommendation: the Wiltshire Wills project set up a space within the Record Office suitable for the digitising work to be done

5.3 Staffing

One full time member of staff should be appointed for one year in the first instance to oversee the initiation of the digitisation process.

Main Criteria for the post:

- This person should be a trained digital camera operator with experience of working with cultural and heritage material such as the wills.
- They must have a good knowledge of the whole digitisation process and be able to implement the file naming scheme.
- They must have a professional level of expertise with image processing software to be able to work with the digital images.
- They must be able to work with the archivist to record the identified metadata and to implement this into the CALM 2000 catalogue.
- Experience with the Phase One single shot camera, while not essential, would be preferred.

Recommended Salary within this range:

Net Pay	Pension Scheme: estimate at 14%	Nat. Ins	Total Cost
16,286	2,280	1,100	19,666
17,238	2,413	1,187	20,838
18,185	2,546	1,274	22,005

Recommendation: a member of staff be employed to get the digitisation aspect of the project underway. The appointment of a digitisation specialist should initially be for a two-year period

Recommendation: the digitisation specialist should report to the Wiltshire Wills Archivist;

6 Section 6: Support and Maintenance for a five year period

6.1 Equipment (Hardware & Software)

The Project needs to estimate that it will cost between 10% and 15% for maintenance of the hardware and software in each of the subsequent years. This would result in annual running cost of between 5k and 7k per year.

6.2 Scanning Operations

The Scanning operations will cost about 25k per year including staff costs and overheads.

In addition the consumables for the project will run at about 5k for DVD and DLT media (see below)

7 Section 7: User evaluation and Focus Groups

7.1 Focus group meeting with the users of the Wills

The user base for any digital project is an essential aspect that must be considered during all decisions taken during the digital process. The quality and access to the digital images require a full understanding of the user's needs, the user's comprehension of the digital objects and the practical issues that are a pivotal to the users' ability to access the objects. While digital objects are by their very nature, flexible and adaptable for many users, and indeed this is often a driving force behind many digital projects, it should be recognised that the initial and principal user base should help drive decisions where appropriate.

It was essential that we met with representatives of the main users groups to discuss their needs and to explain some of the outcomes of such a project. This meeting was arranged in advance of the site visit by the Wills archivist who identified a sample of users to represent the main areas of research using the wills. This focus group consisted of four people with the following areas of interest:

- A Victoria County Historian
- Local Family History Group Representatives
- Chair of the Family History Society
- Local Historian, Editor of the Wiltshire Records ???

The meeting was led by the feasibility study team and allowed a free and open discussion about the possibilities from digitising the wills. These users all use the Record Office frequently and also use the wills regularly for a variety of purposes depending on their area of interest.

The users identified their main desired outcomes from any digital project:

- To be able to identify the document from the catalogue
- To see the minutiae of the document, often photocopy reproduction is not adequate to examine fine handwriting, etc
- Surname searching for property passing between families
- Surname search for relationships and occupations, e.g. surname and place
- Search for beneficiaries and the content of the wills, i.e. a search of the inventories

The searching facilities desired would be available when the archivist has completed the catalogue for the wills but not all. The inventory searching will not be possible. It was explained that while the wills would be in digital form, it would be as an image and as yet there were no plans to turn this into searchable text by OCR or another process. However, it is recognised that while OCR cannot process handwriting such as is contained in the wills, it is probable that such software will be available in the future, so any digitisation process done now would have one eye on this possibility.

During this focus group meeting, it was decided that while the users had an excellent knowledge of the wills, the digitisation chain and technical aspects were not necessarily transparent to all. The feasibility study team explained the process and also decided to organise a front-end evaluation study to discover the user groups' response to two areas; printed facsimiles and on-screen digital images. The results of these evaluation follow.

The following issues were raised during the meeting:

- Likely to be elderly users so onscreen would be advantageous
- Digital facsimiles should be able to be printed at a variety of sizes and speeds
- Access: both remote and local, in particular the effect of making the catalogue available world-wide on the level of queries about the wills.
- User frustration in slow internet access
- Users would be willing to pay for a transcription but would require free access at a local level to the records

7.2 The Print Survey

During the visit, the survey team scanned two wills on a flatbed scanner kindly lent by the Archaeological section of the Record Office. The wills were scanned at variety of resolutions and bit depth. The table below specifies the settings:

Printed Facsimile	Resolution - DPI	Bit Depth - Colour Information
1.	100	B/W (Bitonal)
2.	300	B/W (Bitonal)
3.	600	B/W (Bitonal)
4.	100	Grayscale 8 Bit
5.	300	Grayscale 8 Bit
6.	600	Grayscale 8 Bit
7.	100	Full Colour 24 Bit
8.	300	Full Colour 24 Bit
9.	600	Full Colour 24 Bit

These were all printed on a colour laser printer at 600 dpi in HATII at the University of Glasgow. Three sets were sent to the Record office with a set of evaluation questions designed to discover the users approach to the printed facsimiles and what was the attitude to paying for a copy of a printed facsimile. The questionnaire is included in the appendices. The folders were distributed by a dedicated member of staff who asked the visitors if they would be willing to complete a survey and sat with them whilst they did so - not least to make sure they did not flip forward through the images as it was stressed this should be avoided. The finished questionnaires were then returned to the archivist.

Two wills were scanned for the evaluation, one will was used for the first eight examples and the second will was used for the full colour 600dpi printout. This will has less readable handwriting and was used to determine if the high resolution, full colour version really was preferable to the lower resolution grayscale or bitonal images. As the results show, the handwriting was an issue as the legibility was determined by users not due to the resolution but if effect from the quality of the handwriting in the will.

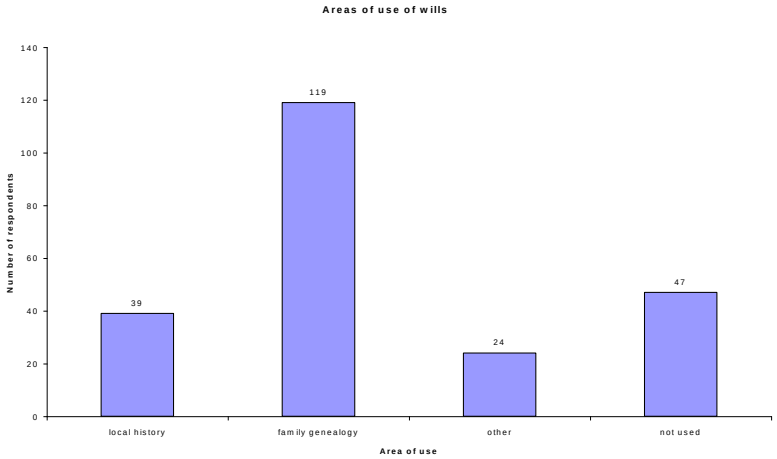
The survey showed some interesting results which are explained more fully below. However, the archivist was keen to raise some concerns she had about some of the responses to the printed facsimiles. These are detailed after the results.

We received 215 completed questionnaires, which represents a good range of users over a period of a month at the beginning of 2000.

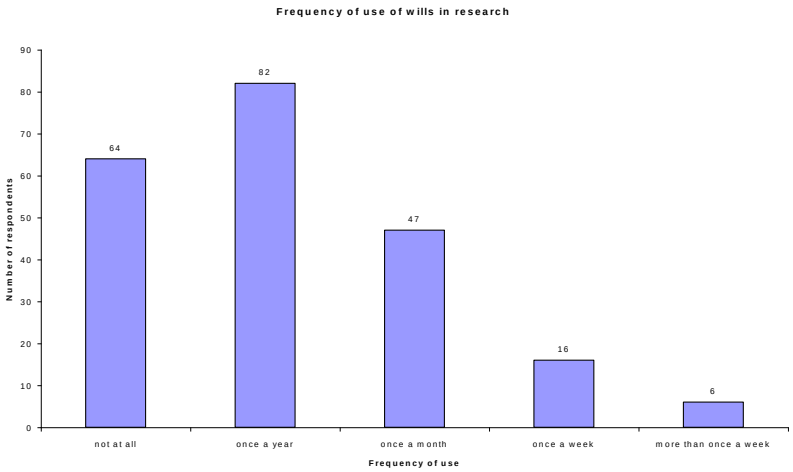
The results were keyed into an excel spreadsheets and the results were obtained by comparing a variety of criteria.

7.2.1 The Use of the Wills

This chart shows the type of research that the wills are used for, family genealogy is by far the greatest and is likely to expand as the wills become more accessible.



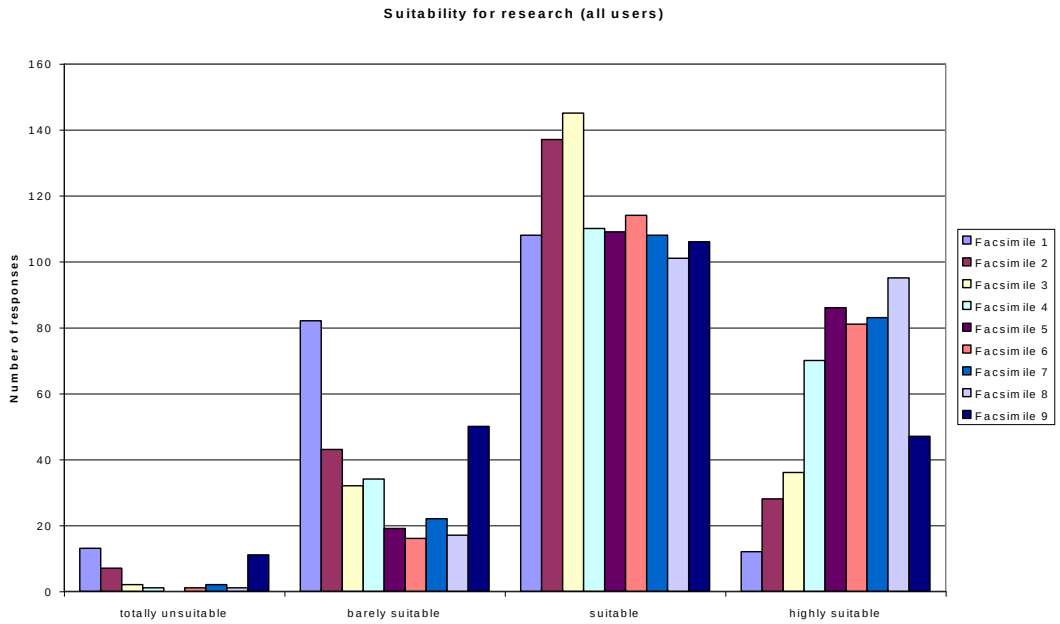
The wills are used mainly be family genealogy and this chart shows how often the users actually use the wills in their research. The majority of users only use the wills once a year or less. Only a very small number of people use the wills once a week or more. However, this would suggest that once the catalogue is in place with on-line digital versions, the access to the wills will increase greatly.



These results show a small, dedicated number of users using the wills in regular research but interest anticipates a increase once the digital versions are available.

7.2.2 Printed Facsimile Preference

This chart shows the overall response to the printed facsimiles from all 215 completed



questionnaires:
Interestingly, facsimile 9 is regarded as totally unsuitable or barely suitable by a high number, but this can be explained by the different handwriting on this will. The archivist has some comments on this:

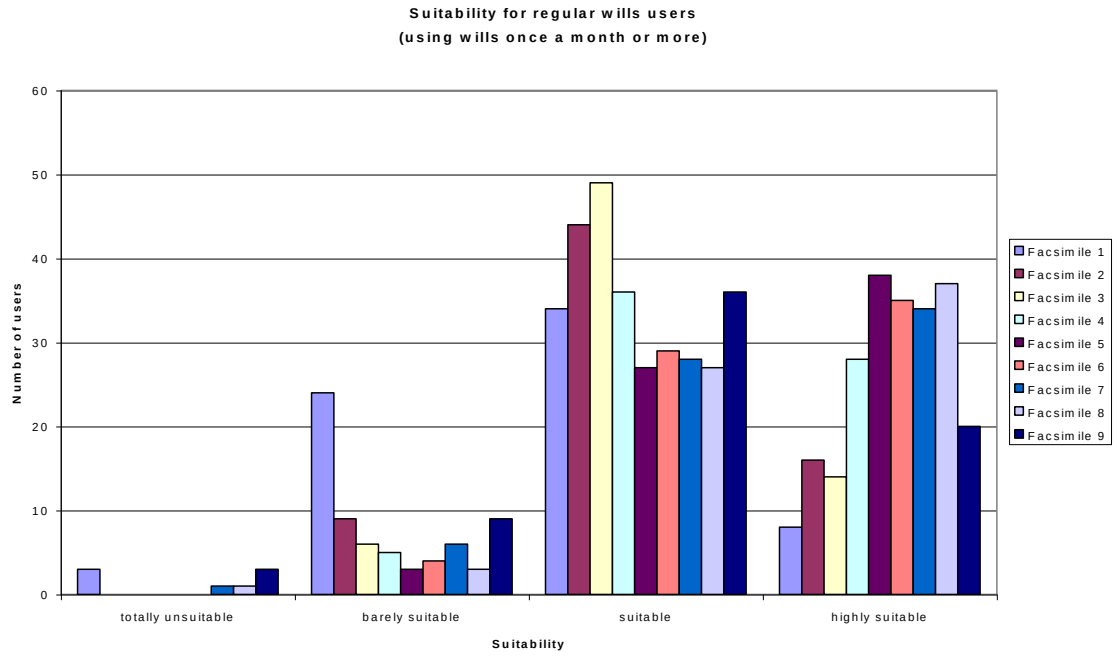
"A comparatively high percentage of readers described document 9 as illegible or barely legible. The image was actually very clear, suggesting that the problem lay with the hand-writing rather than the image."[14]

The bitonal images also seemed to be suitable, more so than the grayscale or full colour images; once again

" I was surprised by the percentage of readers who considered the one-bit images legible - particularly images one and two. Although I personally surveyed only a small number of people several of them said, "Paul Corston - oh yes, that's quite legible," whereas the name is actually Paul Weston. The images only appeared to be legible. It might therefore be advisable to err on the side of caution when considering the legible and highly legible reactions."[15]

[14] Lucy Jefferis, Wiltshire Wills Archivist
[15] Ditto.

However, it is clear that the users do not need to have 600 dpi full colour printed facsimiles to work from. This means that the Wiltshire Wills project can make access easier and cheaper by using 300 dpi grayscale.



This chart shows the response from regular users of the wills (more than once a month). Interestingly, the pattern is similar. Only the 100 B/W image and all the colour images are regarded as totally unsuitable. However, they certainly find the grayscale and full colour highly suitable, apart from the 600 dpi full colour will, which is thought to be explained by the handwriting. From these results, it would seem that 300 B/W image is sufficient for research as a printed facsimile, but as the archivist warns, it may be better to err on the side of caution.

Recommendation: the images used for printing copies of wills in response to requests from the general public be 300 dpi grayscale, which is a standard that the evaluation report indicated was suitable

Recommendation: a charging system be put in place for the provision of laser printed facsimiles of the Wills;

7.3 The Image Survey

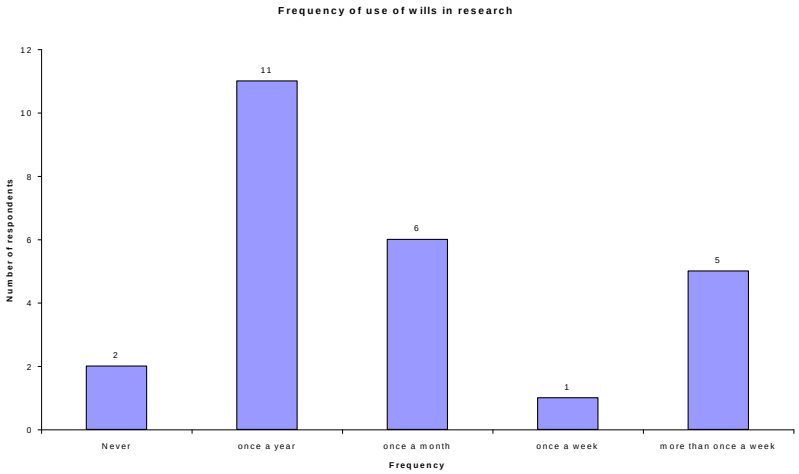
The same nine digital images were used for this survey as were used for the printed facsimile survey. They were loaded on to a CD using a image viewer that allows the user to move from

one image to the next in sequence and to zoom in and out on specific areas of the image. There was a smaller response to this survey, 25 responses in total as the CD had to be viewed on the archivist's PC and thus the number of responses was of course lower. The questionnaire for the image survey is included in the appendices.

Digital Facsimile	Resolution - DPI	Bit Depth - Colour Information
A	100	B/W (Bitonal)
B	300	B/W (Bitonal)
C	600	B/W (Bitonal)
D	100	Grayscale 8 Bit
E	300	Grayscale 8 Bit
F	600	Grayscale 8 Bit
G	100	Full Colour 24 Bit
H	300	Full Colour 24 Bit
I	600	Full Colour 24 Bit

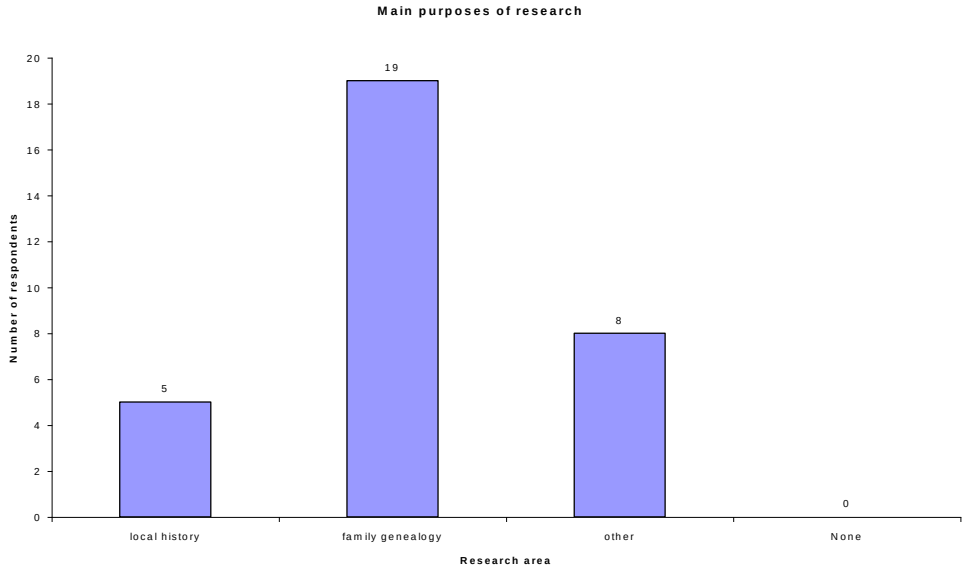
7.3.1 Frequency of use

This graph shows the frequency of use of the wills by the people who completed the questionnaire. There is a greater use of the wills than in the print survey but this can be explained by the smaller sample and that they were identified by the archivist as good



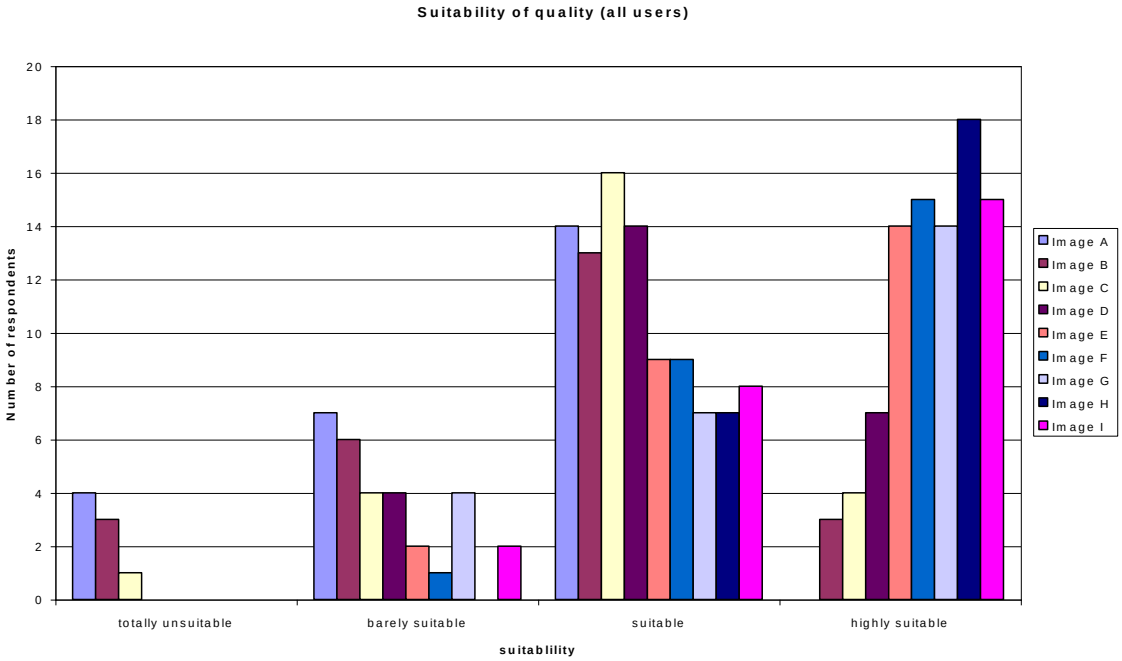
subjects for this survey.

7.3.2 Use of Wills



This chart shows that once again the main use of the wills is by family genealogists. Such data must be considered in all the decisions taken about the Wiltshire Wills project.

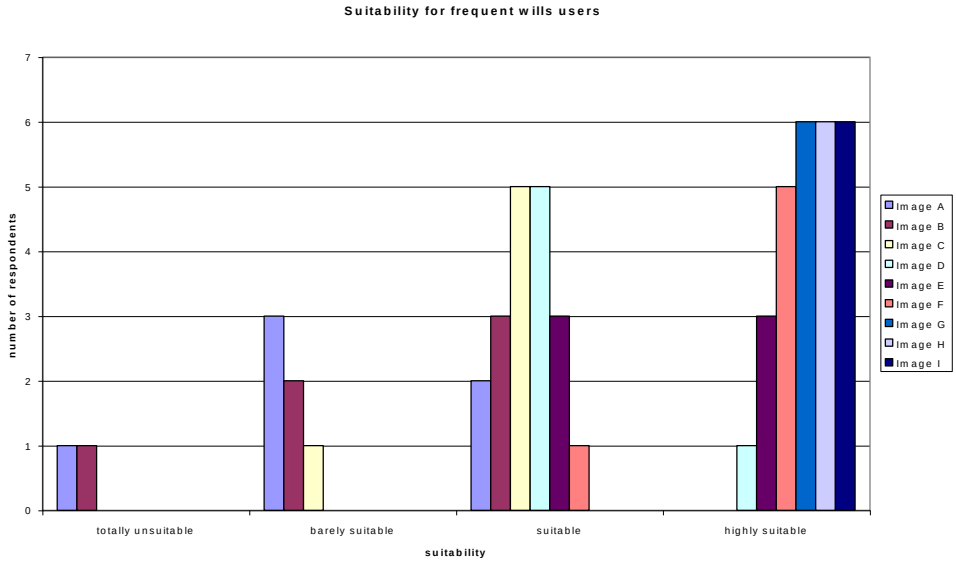
7.3.3 Response to Digital Images



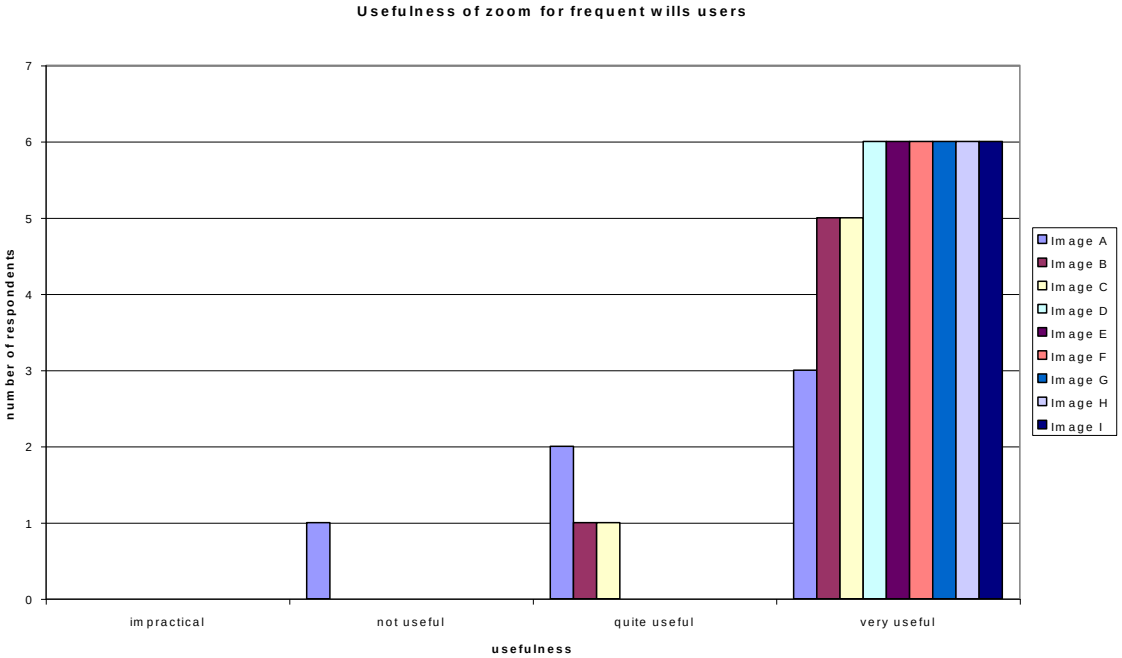
It can be seen from this chart that more expected results were found. Most users found the lower resolution images unsuitable. Once again, the 600 full colour will does not rate the most suitable, but this is explained by the handwriting on the actual will. The full colour 300 dpi is by far the most suitable, however the 300 grayscale is popular as well. Access to the

wills on digital format will be dictated by the PCs available in the record office, but 300 grayscale is more than adequate.

The following chart shows the response from the regular users of the wills



Here, it can be seen that the full colour images are vastly preferred to the other wills. Regular users will need to see the colour information as well as the content and this is a fair comment. However, the grayscale files are more than adequate.



This chart clearly shows that the zoom facility is a very useful tool. This is one of the main features of a digital image and it is encouraging to note that the users will find this aspect so useful in their research.

While the results are vital to the project, the second will shows that users identify with the legibility of the will before recognising the increased resolution or colour information. The Print Survey was undertaken by users who are not at all familiar with the wills and have no notion on how the wills might be used for research and thus base their responses on the perceived legibility of the wills. However, this is not to infer that those questionnaires are invalid, one of the main goals of the project is to increase access to the wills and with this access will come a variety of different users who will be using the wills because they will be able to and thus increase their knowledge of archival materials.

Recommendation: the images be made available to users in the Wiltshire and Swindon Record Office (a at 300 dpi colour and to remote users at 100 dpi greyscale;

Recommendation: the Project use a web-based front-end to provide users with access to the digital images;

Recommendation: the Record Office only store low resolution images (72dpi 8-bit greyscale) online and that the larger images be stored off-line;

Recommendation: given the high level of computer literacy among will users that the Wiltshire and Swindon Record Office only deliver the wills in digital form

8 Section 8: Standards and Policies

8.1 Quality Assurance

Scanning is only one part of a digitisation project. Significant staff time and technical expertise are required to prepare materials for scanning, monitor progress, and perform quality review. The quality review is a vital component of any digital project. Benchmarks must be set that each batch of images can be checked to ensure consistent quality of digitisation.

Features to be verified in the quality assurance process:

- Resolution consistency
- Colour consistency
- Colour target consistency
- Full image capture - no area of object missed
- Progression of sources consistent
- No noise (dust, etc) captured

- Naming convention adhered to
- Metadata captured correctly

These checks should be carried out regularly throughout the whole project to ensure that any problems are identified quickly and rectified.

Quality assurance is a time-expensive exercise but must be carried out if the project is to achieve the aims and objectives. It is advised that a regular check is established for every 100 images or less. It is also advised that Quality Assurance checks are more thorough at the start of the project and can be lengthened as the project progresses presupposing that the Quality Assurance checks have not shown any problems.

8.1.1 Quality Assurance Procedures

A quality control program should be initiated, documented, and maintained throughout all phases of the digital conversion. The quality control plan shall address all specifications and reporting the requirements associated with each phase of the conversion project.
The digital imager should be responsible for performing all inspections or evaluations of the quality of all digital images during production to ensure the quality of the digital images. The Project Archivist should ensure that the benchmarks set out are agreed and adhered to throughout the project.

Quality Control Summary: The digital imager shall provide a summary report of all quality control inspections performed for each batch of digital images produced. Report shall be submitted with the digital files.

8.1.2 Inspection of Digital Files

The overall quality of the digital images should be evaluated using the following procedures. At a minimum, 10 images or 10 % of each batch of digital images, whichever quantity is larger, shall be inspected for compliance with the digital imaging specifications and for any one of the following defects:

- image not the correct size
- image not the correct resolution
- incorrect file format
- incorrect mode, color image is a grayscale
- incorrect bit depth
- loss of detail in the highlights or shadows
- uneven tonal values or flare
- overall too light or too dark
- overall too low or too high contrast

- interference patterns
- lack of sharpness
- excessive sharpening, including unnatural appearance and halos around dark edges
- improper image orientation, such as backwards, up-side down, side-ways, etc.
- excessive noise, usually noticeable in the darker portions of the image
- misalignment of color channels in RGB images
- incomplete or cropped images
- excessively large border area
- image not centered or skewed images
- missing scan lines or dropped-out pixels
- image processing and scanner artifacts, such as extraneous lines, noise, banding, etc.
- dithering on master files or poor quality dithering on access or thumbnail files
- poor quality interpolation on small access files and thumbnail files
- overall color cast and inaccurate color balance
- improper file name
- incomplete or incorrect header information

8.1.3 Testing Results and Acceptance/Rejection

If more than 1% of the total number of images in a batch, based on the randomly selected sampling, are found to be defective for any of the reasons listed above, the entire batch should be imaged again for re-inspection of the batch and correction of the specific errors. If less than 1% of the batch is found to be defective, then only the specific defective images that are found shall be redone.

Recommendation: during an initial two month period the Project will establish standards and benchmarks for the digital process;

Recommendation: the Project should establish strategies that ensure the quality and consistency of the digital images

8.2 Metadata

Metadata is needed to improve the effective longevity of digital data by ensuring the future accessibility and readability. The longevity of digital information is constantly threatened by the combined threats of limited media life and the rapid evolution (and obsolescence) of the software and supporting hardware systems needed to access digital data. These factors bring about the limitation and the effective lifetime of digital materials despite the fact that they can be copied perfectly.

Media longevity issues can be addressed by copying (or "migrating") digital data periodically to new, fresh media; with this future migration, metadata must be available to ensure a smooth and efficient migration to ensure long-term access and usability.

- Metadata schemes are coherent systems for applying metadata to digital objects
- ISBD (International Standard Bibliographic Description)
- MARC
- AACR2 (Anglo-American Cataloguing Rules)
- LCSH (Library of Congress Subject Headings)
- LCC (LoC Classification) or DDC (Dewey Decimal Class.)
- Archival Description is ISAD(G) compliant

8.3 Research Library Group Guidelines for Preservation Metadata

"A significant component of creating and managing digital collections is ensuring that the information essential to their continued use is preserved in an accessible form. The Working Group on Preservation Issues of Metadata was constituted in May 1997 as a first step in the process of addressing this issue. The group was asked to identify the descriptive data elements that should be associated with digital master files that have preservation-based intent."[16]

The following points describe the 16 data elements that should be used in preservation metadata:

Date & Transcriber

- Date Definition: Date file created
- Date Format: yyyyddmm

Transcriber Definition

- Required: Name of transcribing agency
- Optional: Individual transcribing metadata

Producer

- Producer Definition: Agency responsible for the physical creation of the resource
- Optional element may include: identity of the individual who carried out the original scanning.

Capture Device

- Definition: Make and Model of Digital Camera or Scanner

[16] http://www.rlg.org/preserv/presmeta.html

- e.g. Kontron ProgRes 3012

Capture Details

- Digital Camera Definition:
  Lens type
  Focal length
  Light source type
  Tiled image

Scanner Definition:

Name of scanner
Scanner settings
Gamma correction

Change History

- Definition: Record of modifications made to file, versions generated and by whom and when
- Example: details of migration, recording of cropping, etc.

Validation Key, Encryption, & Watermarks

- Validation Key: a way that the contents of a file can be verified, e.g. checksum
- Encryption: a way of encoding data so that it must be decrypted using a pre-defined access key (RSA Public Key Crytosystem
- Watermark: A digital mark which is introduced into an image to provide evidence of its origin/ownership

Resolution

- Pixels per inch, dots per inch or some other density measure for recording the levels at which the image was scanned (e.g. 300 dpi, 600 dpi)

Compression

- Note whether or not the file has been compressed and if so describe the algorithm used to compress it (e.g. LZW, JPEG)

Source

- Physical characteristics of the original and its place in the generational chain. Note also any changes made to the source to make its digitisation viable (e.g. source type, size, condition)

Colour & Colour Management

- Colour: Pixel depth (1-bit; 8-bit; 24-bit;)

- Colour Management: Record says used to improve consistency of colour across, capture, display, printing (e.g. OptiCal)

Colour Bar/Grey Scale Bar

- Indicate presence or absence and type

Control Targets

- Information about targets included in the scan file for quality control, calibration, edge and detail measurement

Recommendation: the metadata for the digital images conform to at least the Research Library Group's preservation standards

8.4 Dublin Core

15-element metadata set designed to facilitate discovery of electronic resources

Features

- simple so it can be used by non-cataloguers
- supports semantic interoperability across disciplines
- flexible
- extensible
- based on international consensus

Dublin Core Elements

- Title ("Title")
- Creator ("Creator") Subject and Keywords ("Subject")
- Description ("Description")
- Publisher ("Publisher")
- Other Contributor ("Contributor")
- Date ("Date") Resource Type ("Type")
- Format ("Format")
- Resource Identifier ("Identifier)
- Source ("Source)
- Language ("Language")
- Relation ("Relation")
- Coverage ("Coverage")
- Rights Management ("Rights")

8.5 Encryption and Watermarking

Watermarking is the process of introducing a digital mark into an image to identify the source, creator, owner, distributor, or authorised consumer of a document or image. In event of illicit use, it can facilitate claim of ownership, prosecution, receipt of copyright fees.

- Visible and invisible (resembles paper one)
- Diversity of techniques

A digital watermark must follow these requirements:

- Digital mark must remain after processing / compressing the image
- It should not interfere with viewing of image
- It should be difficult to remove
- Invisible watermarking should be detectable by proper authorities

Recommendation: where digital images are provided over the Internet or on fixed media (CD-Rs) that these images be watermarked to ensure that the copies which are redistributed can be identified as the property of the Wiltshire and Swindon Record Office

8.6 Digitisation Standards

Best Practice Guidelines recommended by the HATII Digitisation Summer School should be adopted.

Recommendation: the Project establish procedures and policies to ensure that the digitisation work is done to suitable standards and with adherence to appropriate Guidelines for Best Practice

8.6.1 Compression: Lossy and Lossless

There are basically two types of compression methods: lossy and lossless. *Lossy compression* creates smaller files by discarding some information about the original image. It removes details and colour changes it deems too small for the human eye to differentiate. *Lossless compression*, on the other hand, never discards any information about the original file.

- Lossy refers to data compression techniques in which some amount of data is lost. Lossy compression technologies attempt to eliminate redundant or unnecessary information.

- Lossless refers to data compression techniques in which no data is lost. The PKZIP compression technology is an example of lossless compression. For most types of data, lossless compression techniques can reduce the space needed by only about 50%. For greater compression, one must use a lossy compression technique.

8.7 Data Capture

Recommendation: all the wills are digitised at 600 dpi at both 24-bit colour and 8-bit greyscale;

8.8 Preservation Standards

It is important that the Project makes adequate provision for longer-term preservation of the archive images so that they are available for the use and enjoyment of future audiences. Consequently, a master set of archive images stored on two different storage media will be transferred to the an environmentally controlled archive store. The two different media shall be chosen from the following list: DVD-R and DLT.

The choice of image format and optical storage media for the archive image is therefore extremely important. The durability and stability of current optical media is known to be extremely variable. In addition, the format of the archived copy must be as 'open' as possible with respect to the guarantee of future portability and exploitation of new technology such as compression techniques. The archive copy must not, for example, be stored using a lossy compression technique (i.e. that loses information) that precludes reformatting the images using a future technique which yields lower losses in content.

8.9 File Formats

"The *Graphics Interchange Format* was developed by CompuServe in 1987 to store multiple bitmap images into a single file for easy exchange over computer networks. The GIF is the oldest graphic file format on the Web, and nearly all browsers support it (except Lynx, of course). GIFs support up to 8 bits per pixel, which means a maximum of 256 colours (2^8=256 colours), 4-pass interlacing, transparency, and uses a variant of the Lempel-Ziv Welch compression algorithm.

LZW is a lossless compression algorithm and compression/decompression times are symmetric. LZW is a repeated-string compressor, it uses a data dictionary (also called a *translation table* or *string table*) to represent linear sequences of data in the uncompressed input stream. The first time a sequence is encountered a code is added to the dictionary. Any subsequent matching sequences are represented by this code." [17]

8.9.1 PNG Portable Network Graphics

- PNG designed to be a successor to GIF
- Indexed colour images; 24-bit
- Supports image streaming
- Transparency
- Additional Information can be stored in the file
- Complete hardware and platform independence
- 100% lossless compression

[17] http://www.webreference.com/dev/graphics/compress.html

- Calibration information (e.g. gamma data) stored

8.9.2 JPEG: Joint Photographic Experts Group

- Stores colour information as RGB
- Compresses files by identifying and discarding extra data not essential to display
- Decompressed images not identical to original
- JPEG can achieve 10:1 or 20:1 compression without visible loss
- Visual sensitivity to brightness means that greater hue compression than colour is possible

8.9.3 TIFF: Tagged Image File Format

- Created in 1986 by Aldus
- Designed to capture images from scanners, frame grabbers, paint/photo
- Raster image format
- de-facto industry standard for images
- Uses tags to identify individuals fields
- Images as: bi-level, greyscale, palette-colour, full-colour

8.9.4 File Formats for the Project:

- The Project should adopt the JPEG format for end-user presentation.
- For Archival purposes the project should adopt TIFF with LZW compression.

TIFF RGB (18Mb, ~12MB with LZW) for data capture and archive, JPEG min compression (~3.6:1) for on/near-line storage. Probably move to JPEG 2000 when it is released.

Recommendation: the project adopt JPEG standards for the creation of images for delivery to the general public;

8.10 Access

Access is one of the most important features when approaching a project such as the Wiltshire Wills. Digital images give huge possibilities for increased and enhanced user access to the wills.

As has been seen, the current finding aids do not give users the ability to cross-reference search easily. The cataloguing that is in progress will facilitate this greatly. Ideally, users would want to access the catalogue on line and then view digital images of the wills themselves, examine the will and then refer to further wills. It is a wish of the user group to

be able to search the wills themselves for names and property. This is not part of the Wiltshire Wills project but as technology advances the ability to recognise handwriting and create electronic text from even 15 century samples may be a possibility. The Wiltshire Wills project must strive to ensure that the digital images of the wills available to technologists in the future enable them to use this (as yet non-existent) software to its full potential.

Access to the wills is one of the main aims of the project but with increased access comes increased demand. If the Wiltshire Wills are fully available to the world via the internet, the increase in demand for digital images, information and thus the time of the record office staff will increase exponentially. While this may be a long-term goal, the project staff are strongly encouraged to ensure that the record office will be able to sustain the increased level of interest.

The current users of the wills can be given access to the catalogue and the digital images through a dedicated PC or a small network of PCs in the reading rooms within the record office. The number of workstations will be determined by the long-term ICT strategy enabled by the Information Service for the County. This scenario is to be encouraged to enable further digital projects to have a ready made platform for access.

8.10.1 Naming scheme

The digital files will have associated metadata that will follow the RLG guidelines for preservation metadata. The Imaging technician (section 5.3 and 9.2) will liase with the archivist to capture this metadata. The digital file naming scheme is vital to facilitate access and reference to the CALM 2000 catalogue. The study team proposes the following schemes as probable methods:

- The catalogue reference number
- The courts e.g. Arch Wilts, Arch Sarum etc

The naming scheme must be able to be cross-referenced with the catalogue to enable access to the images of the wills directly from any search results.

By establishing names for the digital images early, descriptive materials can be prepared independently of the digitisation process. The naming scheme also provides a structure for project control and for defining which materials should be digitised at what time. Names can relate digital representations to the corresponding original items during the production

process. The naming scheme can be the basis for monitoring progress, logging problems during the scanning process, and performing quality assurance checks.

Recommendation: the project adopt non-proprietary and system independent index and file naming conventions that are cross-platform and application independent (see section 9 for a discussion of the system storage options) to enhance the ease of migrating the material to a new environment

8.10.2 File formats

The digital files made available to the users will be of lower size and resolution than the archival versions. See Section 7 on the user evaluation for recommendations and Section 8.9 for information on the file formats.

8.10.3 Web based interface

The application used to access the on-line catalogue and the digital images of the wills should be a web based format. This will ensure that any programming work done at the conception will be able to be converted easily to enable full internet capability in the future, should that be the route the Wiltshire Wills project decides to follow.

There are a variety of software systems capable of implementing such a web based interface. The study team would strongly recommend that the Wiltshire Wills explore the functionality of XML as a method of encoding the images and associated databases of metadata and cross-referencing to the catalogue.

Recommendation: offline storage be on DVD media which can be loaded in response to on-demand requests from users

9 Section 9: Technical Infrastructure

9.1 The Camera

The study team has recommended the PhaseOne camera. See the enclosed press release and pricing figures.

9.2 Camera Operator (see also section 5.3)

Imaging Technician

Main Responsibilities

To prepare digital images of the Wiltshire Wills

Specific Responsibilities

- Liase with the archivist to prepare materials for digitisation
- Capture digital images
- Capture associated metadata
- Inspect images for quality
- Maintain statistics
- Liase with Record Office to train other archive staff in digitisation

9.3 Computer

The Wiltshire Wills project must purchase a computer that is compatible with the PhaseOne camera. The PC chosen must have as these features as standard, with as much capability as possible:

- Processor speed - as high as possible, at least Pentium III
- RAM, at least 250 MB
- Video Card
- Monitor
  - min 17" but if possible 21" (less scrolling)
  - smaller dot pitch is better (i.e. 0.26mm better than 0.28mm)
- Display
  - 256 colours, 24-bit colour (match the colour depth of your scanned images / screen redraw)
  - display resolution (PCs: 80-100)
- DVD read/write unit

9.3.1 Example Computer and Peripherals

The following computer[18] is only an example of the specification required, it is not a recommendation.

Specifications:

Motherboard: ATX Form Factor Motherboard

[18]Text from: http://www.viglen.co.uk/default.asp?hometarget=/product/default.asp&SitePageType=Products

	Intel® 820 chipset,	
	133MHz Front Side Bus	
CPU Options:	**Pentium III:** 600MHz, 667MHz, 733MHz, 800MHz, 866MHz - 256KB Cache	
Memory Options:	RAMBUS memory	
Floppy Disk Drive:	3.5" 1.44MB fitted as standard	
Hard Disk Drive Options:	Full range of ATA 66 IDE drives and SCSI option available: 6.4GB, 10GB, 15GB, 20GB IDE. 20GB, 27GB, 45GB 2700RPM IDE. 9GB, 18GB SCA SCSI (7200rpm and 10000rpm)	
CD ROM Drive:	48x Speed IDE CD ROM fitted as standard	
Graphics:	nVidia TNT2 16MB AGP 4x	
Networking:	Optional	
Manageability:	Onboard Management Processor	
Management Software:	S/W, Intel® LanDesk Client Manager pre-installed	
Expansion Card Slots:	5 PCI slots	
Sound:	Onboard Wavetable Sound	
Keyboard:	105 Key Viglen PS/2 Keyboard	
Mouse:	Microsoft® IntelliMouse	
Standard Operating System:	Microsoft® Windows® 98 SE	
Optional Operating System:	Microsoft® Windows® 95, Microsoft ® Windows® NT 4.0 Workstation or Microsoft® Windows ® 2000	
External Interfaces:	2 Serial, 1 Parallel, 2 USB ports, Mouse & Keyboard Ports	
System Unit Dimensions:	**Desktop:** 430mm (w) x 155mm (h) x 420mm (d) **> Medium Tower:** 180mm (w) x 420mm (h) x 425mm (d) **Fullsize Tower:** 195mm (w) x 622mm (h) x 435mm (d)	
System Unit Expandability:	**Desktop:**	Two 3.5" external Drive Bays (one used) Two 3.5" internal Drive Bays (one used) Two 5.25" external Drive Bays (one used)
	Medium Tower:	Two 3.5" external Drive Bays (one used) Two 3.5" internal Drive Bays (one used) Two 5.25" external Drive Bays (one used)
	Fullsize Tower:	Three 3.5" external Drive Bays (one used) One 3.5" internal Drive Bays (one used) Six 5.25" external Drive Bays (one used)

Expandability: 5 PCI, 1 AGP, 1 AMR
Monitor: Viglen Envy 15" Colour SVGA Monitor supplied as standard
Power Supply: 250W ATX Power Supply
Cost: approx. £1,500.

9.3.2 DVD Recordable[19] (see 9.9.1)

Item	Model	Speed	Type	Cost
CVRpio2s	Pioneer DVR-S201	1x 2x	SCSI	**£2773**

DVD-R = 4.7gb per side. Industry-standard compatibility, discs can be read in Hi-Fi / Movie DVD players etc.

9.4 Storage System

The technical infrastructure within the Record Office does not lend itself to the Wiltshire Wills project buying a server and storing the images on site. The Information Services have to support all the IT services within the County departments, including the Heritage Services. As yet, the county does not have an ICT strategy for the short or long term. This will effect the decisions taken about archival storage and access.
This study will give server options but will not recommend that the Wiltshire Wills project pursue this option.
The CALM 2000 database is currently stored on a County hall server. This can continue as the level of support offered is adequate. The database can also be stored on the chosen storage system.

9.5 Network Server for Record Office[20]

This server is an example of the specifications that the Wiltshire Wills project might consider buying, it is not a recommendation.

[19] Image and Text from http://www.span.com/system/index.htm
[20] Text and Image from:
http://www.viglen.co.uk/default.asp?hometarget=/Product/server_range.asp&SitePageType=Products

Specifications:

Base Board Features	**Processor/cache:**	Single or dual Pentium III processors with 512KB integrated L2 cache
	Processor speeds:	Intel® Pentium®III 600, 650, 700, 750, 800MHz processors 100MHz Front Side Bus 100MHz
Memory	**Memory Type:**	Four 168 pin Gold plated DIMM sockets for 72 bit Synchronous DRAM with ECC up to 1GB of 72-bit 3.3V ECC unbuffered DIMMS
	DIMM Sizes:	128MB, 256MB
Integrated 1/0		Two Asynch, RS-232C, 9 pin Serial Ports Centronics compatible, 25 pin Parallel Port
Integrated Controllers	**SCSI Controller:**	Symbios dual channel - Max data transfer 40 MB/sec
	PCI/ISA IDE:	Two independent channels for four IDE devices
	Graphics Controller:	Cirrus Logic 5480 2MB
Integrated Network Connection		Intel EtherExpress- PRO/100+ - 10/100MB, RJ45
Peripheral Bays/Drives	**Bays:**	Six 5.25" and three 3.5" drive bays
	Drives:	32 speed SCSI CD ROM 1.44Mb 3.5" floppy drive
Expansion		5 expansion slots All 4 PCI slots capable of accepting bus-mastering devices One dedicated ISA One shared PCI/ISA
System Dimensions		62.2 x 19.5 x 43.5 (H x W x D cm)
Server Management		Intel LANDesk Server Manager Emergency management port
Failure Detection		Voltage variation, thermal, operating system watchdog, fan failure, hard disk drive failure, power supply failure, processor status, ECC memory
Event Logging		Non-volatile to prevent loss in event of a power disruption
Cooling		Monitored onboard fan per CPU and 2 chassis system cooling fans

Power Supply	Single 300W	
Standard Warranty	3 years RTB Collect and Return	
Options	**Drive Size:**	1.6" and 1" high Ultrawide, or Ultra2 SCSI LVD drives
	Hot-swap:	Up to two hot-swap drive cradles each supporting three 1" SCA drives
	Tape Backup:	DAT or DLT drives
	RAID Controllers:	Mylex single or dual channel controllers Levels 0, 1, 5 and 0+1 supported Up to 32MB DRAM cache SAFTE, AEMI, SMART RAID solutions up to 72GB
	Network Operating Systems:	Microsoft Windows NT 4.0 Server, Novell Netware, SCO Unix, Citrix
	Configuration service:	Pre-configuration service of operating systems as required

Cost: approx. £30,000

9.6 Leasing storage space

For security and long-term safety of the Wiltshire Wills digital images, the Wiltshire Wills project should consider leasing storage space on a server in a remote site. This would give added security and long term viability to the materials.

The materials can either be stored on a remote server or on DVD discs and eventually microfilm in a secure environment. The record office will store the DVD discs created by the digitisation process for access. When all the project goals have been reached, there should be a set of DVD discs available in the Record Office and an access set of microfilms. The archival versions should be stored remotely in a secure environment.

9.6.1 National Data Repository: http://www.ulcc.ac.uk/services/ndr.htm

"The National Data Repository at ULCC is designed to deal with problems of digital preservation and large-scale data distribution increasingly faced by many organisations. It provides a network-accessible digital archive and filestore, based on a robotic tape system which can provide access to up to 300 Terabytes of data. The system provides the illusion of

an extremely large online filestore, accessible via the means that suit you - the web, FTP, or more specialised mechanisms - at high speeds via the SuperJANET network. The data is actually held on high-speed digital tape, and brought online automatically whenever it is required. Data is kept secure and automatically migrated to new media as required, relieving the owner of the worry of maintaining data readability. The user gets almost all the advantages of online disk files, but at a cost closer to that of tape. "[21]

This remote storage facility is to be recommended for the Wiltshire Wills project as the storage centre is part of the Cultural and Heritage sector and understands the importance of the content of the data. Business disaster prevention companies will offer similar services but without the necessary appreciation of the content.

The staff at ULCC National Data Repository centre can offer specialist advice on the formats to store and retrieve the materials. Contact can be made by email service@ulcc.ac.uk or by telephone: 020 7692 1692.

9.6.2 NDAD: National Digital Archive of Datasets : http://ndad.ulcc.ac.uk/

"The UK National Digital Archive of Datasets (NDAD) is currently in development at the University of London Computer Centre (ULCC). Its aim is to conserve and, where possible, provide access to many computer datasets from Central Government departments and agencies. The data will remain in the legal custody of the Public Record Office (PRO), but will be managed by the ULCC and the University of London Library (ULL). The NDAD will preserve this important data from the ravages of time and technology, and make it readily available to future generations. "[22]

9.7 Storage Media

9.7.1 DVD: Digital Versatile Disc

DVD -- digital versatile disc, also known as digital video disc. This is a generic term that can apply to both DVD drives and discs.
DVD-ROM -- DVD-read-only memory, the computer-oriented DVD disc format. Essentially similar to a higher-capacity CD-ROM, these discs cannot be recorded or erased by the end user.

[21] http://www.ulcc.ac.uk/services/ndr.htm
[22] http://ndad.ulcc.ac.uk/

DVD-RAM -- DVD-random access memory. A square cartridge based on dual phase rewritable disc technology similar to the PD PhaseWriter drives. DVD-RAM discs can be rewritten up to 100,000 times. "Type 2" discs hold 5.2GB of information.
DVD-R -- DVD-rewritable. A write once, read many (WORM) version of DVD. Discs that have been written in this format can be read in most standard DVD-ROM players.
DVD-R/W -- DVD-read/write. A DVD format that can be rewritten up to 1,000 times. DVD-R/W discs can be read in most standard DVD-ROM players. Pioneer is the developer of (and is currently the only company developing drives for) this spec. Pioneer says this format is essentially the same as DVD-R, but rewritable. It is designed for writing of all files in one pass, like the DVD-R system, and is not suitable for repeated writing of small files or random rewriting.

At the moment DVD-R discs cost approximately 5.2gb available from SMC direct @ £22.00 (ex VAT) each but this price will fall over the next three years to £1 a disc, following the same cost curve as the CD-R.

9.7.2 DLT: Digital Linear Tape

Short for Digital Linear Tape, a type of magnetic tape storage device originally developed by DEC and now marketed by several companies. DLTs are ½-inch wide and the cartridges come in several sizes ranging from 20 to 80 GB. DLT drives are faster than most other types of tape drives, achieving transfer rates of 2.5 MBps

This media costs about £50 per 80GB tape.

9.7.3 DAT: Digital Audio Tape

DAT (4mm) Technology

DAT (DDS-2) drives store 4.0 GB per tape and transfer 0.366 MB/s uncompressed. With 2:1 compression, the capacity is 8.0 GB and speed is 0.732 MB/s.

DAT Media
A DDS-2 cartridge costs £15-20.

9.7.4 CDR

CD-R is short for "CD-Recordable". Recordable CDs are WORM (Write Once, Read Multiple) media that work just like standard CDs. The advantage of CD-R over other types of

optical media is that you can use the discs with a standard CD player. The disadvantage is that you can't reuse a disc.
A related technology called CD-Rewritable (CD-RW) allows you to erase discs and reuse them, but the CD-RW media doesn't work in all players. CD-Rewritable drives are able to write both CD-R and CD-RW discs.
All CD recorders can read CDs and CD-ROMs, just like a standard CD-ROM drive.

Recommendation: the security copy of all the digital images on DVD and DAT be stored off-site in suitable conditions (e.g. 30-40% relative humidity and 15ºC and following industry management standards

10 Section 10: Summary of the Conclusion and Recommendations

The storage requirements for this project would be immense. We have estimated that we are looking at roughly 300,000 pages, although we do not have a precise estimate. Using the bound volumes as a benchmark we have estimated that at the optimal and only archival resolution of 600dpi and 24bit colour the storage required by the project would be extremely expensive. Just the 17,274 pages of the Wills held in bound volumes would take roughly:

- 17 terabytes to store at 600 dpi;
- 4 terabytes to store at 300 dpi; and
- 246 gigabytes at 72dpi.

This means that it will be impossible for the project to implement a single integrated solution with all the data on line would be impossible to achieve. The likely outcome is that each bound volume could be store on one or at most two DVDs at current screen resolution (72dpi). This is a lower resolution than the User found acceptable (see Section 7). The lowest resolution for viewing and printing that found widespread acceptance with the users was 300dpi at 24bit colour. This would require the splitting of some material across DVDs, but with good indexing this should not pose a problem.

11 Appendices

11.1 Survey of Printed Facsimiles from the Wiltshire Wills

Background. Please answer the following questions about you and your research:

1. Name of your home village / town / city? …….

2. How many years experience do you have using record offices/archives?
   1 year or less ❑ 2 - 3 years ❑ 3 - 5 years ❑ more than 5 years ❑
3. How often do you use wills in your research?
   Once a year ❑ once a month ❑ once a week ❑ more than once a week ❑
4. Can you estimate how many wills you accessed from this office last year?……
5. What is the main purpose of your research when you access the wills?
   Local History ❑ Family Genealogy ❑ Other……

Questions on the Facsimiles

Now please look at the folder containing facsimiles of the wills. These facsimiles were printed from digital images of the wills.
Answer the questions relating to each facsimile **BEFORE** moving to the next facsimile. Each facsimile is named on the dividing card and on the facsimile itself, e.g. one, two, etc.

Facsimile one

6. Do you find the quality of the facsimile for your research?
   totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑
7. In your opinion, is this facsimile:
   illegible ❑ barely legible ❑ legible ❑ highly legible ❑

Facsimile two

8. Do you find the quality of the facsimile for your research?
   totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑
9. In your opinion, is this facsimile:
   illegible ❑ barely legible ❑ legible ❑ highly legible ❑

Facsimile three

10. Do you find the quality of the facsimile for your research?
    totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑
11. In your opinion, is this facsimile:
    illegible ❑ barely legible ❑ legible ❑ highly legible ❑

Facsimile four

12. Do you find the quality of the facsimile for your research?
    totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑

13. In your opinion, is this facsimile:
illegible ❑ barely legible ❑ legible ❑ highly legible ❑

Facsimile five

14. Do you find the quality of the facsimile for your research?
totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑

15. In your opinion, is this facsimile:
illegible ❑ barely legible ❑ legible ❑

Please turn over page

Facsimile six

16. Do you find the quality of the facsimile for your research?
totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑

17. In your opinion, is this facsimile:
illegible ❑ barely legible ❑ legible ❑ highly legible ❑

Facsimile seven

18. Do you find the quality of the facsimile for your research?
totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑

19. In your opinion, is this facsimile:
illegible ❑ barely legible ❑ legible ❑ highly legible ❑

Facsimile eight

20. Do you find the quality of the facsimile for your research?
totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑

21. In your opinion, is this facsimile:
illegible ❑ barely legible ❑ legible ❑ highly legible ❑

Facsimile nine

22. Do you find the quality of the facsimile for your research?
totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑

23. In your opinion, is this facsimile:
illegible ❑ barely legible ❑ legible ❑ highly legible ❑

Charging. Now please indicate in the table below, how much you would be willing to pay for the different types of facsimiles.

Type of facsimile / Cost	**£0.00**	**£0.50**	**£1.00**	**£2.00**	**£3.00**	**£4.00**	**£5.00**

Type of facsimile / Cost	£0.00	£0.50	£1.00	£2.00	£3.00	£4.00	£5.00
Black and White, e.g. facsimile two							
Grayscale, e.g. facsimile five							
Colour, e.g. facsimile eight							

Computing Experience. Please answer some questions about your computing experience.

24. How many hours a week do you use a computer?
    never ❑ less than 5 hours ❑ 5 - 10 hours ❑ more than 10 ❑
25. Do you use your computer for (please tick all that apply):
    word processing ❑ internet ❑ email ❑ database ❑ spreadsheets ❑
26. How many hours a week do you use the World Wide Web?
    never ❑ less than 5 hours ❑ 5 - 10 hours ❑ more than 10 ❑
27. Do you have your own email address? Yes ❑ No ❑

Thank you for completing this survey.
Please return this completed form to a member of staff.

Date Form Completed:……..

11.2 Survey of Digital Images from the Wiltshire Wills

Background. Please answer the following questions about you and your research:

1. Name of your home village / town / city? …….
2. How many years experience do you have using record offices/archives?
   1 year or less ❑ 2 - 3 years ❑ 3 - 5 years ❑ more than 5 years ❑
3. How often do you use wills in your research?
   Once a year ❑ once a month ❑ once a week ❑ more than once a week ❑
4. Can you estimate how many wills you accessed from this office last year?……
5. What is the main purpose of your research when you access the wills?
   Local History ❑ Family Genealogy ❑ Other……

Questions on the Digital Images

Please look at the digital images from the CD. The Wiltshire Wills Archivist will help you to view the files on the computer.

Answer the questions relating to each digital image **BEFORE** moving to the next image.

Digital Image A

6. Do you find the quality of this digital image for your research:
   totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑
7. In your opinion, is the enlargement/reduction options (zoom in / zoom out) of this image:
   impractical ❑ not useful ❑ quite useful ❑ very useful ❑

Other comments:

Digital Image B

8. Do you find the quality of this digital image for your research:
   totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑
9. In your opinion, is the enlargement/reduction options (zoom in / zoom out) of this image:
   impractical ❑ not useful ❑ quite useful ❑ very useful ❑

Other comments:

Digital Image C

10. Do you find the quality of this digital image for your research:
totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑

11. In your opinion, is the enlargement/reduction options (zoom in / zoom out) of this image:
impractical ❑ not useful ❑ quite useful ❑ very useful ❑

Other comments:

Digital Image D

12. Do you find the quality of this digital image for your research:
totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑

13. In your opinion, is the enlargement/reduction options (zoom in / zoom out) of this image:
impractical ❑ not useful ❑ quite useful ❑ very useful ❑

Other comments:

Digital Image E

14. Do you find the quality of this digital image for your research:
totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑

15. In your opinion, is the enlargement/reduction options (zoom in / zoom out) of this image:
impractical ❑ not useful ❑ quite useful ❑ very useful ❑

Other comments:

Digital Image F

16. Do you find the quality of this digital image for your research:
totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑

17. In your opinion, is the enlargement/reduction options (zoom in / zoom out) of this image:
impractical ❑ not useful ❑ quite useful ❑ very useful ❑

Other comments:

Digital Image G

18. Do you find the quality of this digital image for your research:
totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑

19. In your opinion, is the enlargement/reduction options (zoom in / zoom out) of this image:
impractical ❑ not useful ❑ quite useful ❑ very useful ❑

Other comments:

Digital Image H

20. Do you find the quality of this digital image for your research:
totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑

21. In your opinion, is the enlargement/reduction options (zoom in / zoom out) of this image:
impractical ❑ not useful ❑ quite useful ❑ very useful ❑

Other comments:

Digital Image I

22. Do you find the quality of this digital image for your research:
totally unsuitable ❑ barely suitable ❑ suitable ❑ highly suitable ❑

23. In your opinion, is the enlargement/reduction options (zoom in / zoom out) of this image:
impractical ❑ not useful ❑ quite useful ❑ very useful ❑

Other comments:

Time and Quality

Do you agree or disagree with the following statements:

24. I would rather wait some time for an image to load on screen to view a higher quality image.
agree ❑ disagree ❑

If you agreed, how long would you be prepared to wait? .....minutes

25. I would rather view a lower quality image on screen than have to wait some time for an image to load on screen.
agree ❑ disagree ❑

Computing Experience. Please answer some questions about your computing experience.

26. How many hours a week do you use a computer?
never ❑ less than 5 hours ❑ 5 - 10 hours ❑ more than 10 ❑

27. Do you use your computer for (please tick all that apply):
word processing ❑ internet ❑ email ❑ database ❑ spreadsheets ❑

28. How many hours a week do you use the World Wide Web?
never ❑ less than 5 hours ❑ 5 - 10 hours ❑ more than 10 ❑

29. Do you have your own email address? Yes ❑ No ❑

30. Have you ever done any digitising of images or text? Yes ❑ No ❑

Thank you for completing this survey.
Please return this completed form to a member of staff.

Date Form Completed:……..

11.3 Bibliography

Anderson, U. 1997. *Workshop on Electronic Archiving: An Evaluation of the Sesam Report* (Stockholm: Swedish National Archives, Astra AB).

Bagnall, Roger S. 1995. *Digital Imaging of Papyri* (Washington, D.C.: The Commission on Preservation and Access).

Balas, Janet. 1998. 'Copyright in the Digital Era', *Computers in Libraries* 18(6) (June 1998).

Berghel, H. and O'Gorman, L. 1996. 'Protecting ownership rights through digital watermarking', *Computer* July 29 (7): 101-103, [http://www1.acm.org:82/~hlb/publications/dig_wtr/dig_watr.html].

Besser, H. and Trant, J. 1995. *Introduction to Imaging: Issues in Constructing an Image Database* (Santa Monica, CA: The Getty Art History Information Program).

Chapman, A., Kingsley, N., and Dempsey, L. 1999. *Full Disclosure: Realising the value of Library and Archive Collections* (a study carried out by UKOLN and the National Council on Archives) May 1999. [http://www.ukoln.ac.uk/services/lic/fulldisclosure/report.pdf]

Chapman, S. et. al., 1997. *Selection for Digitizing: A Decision Making Matrix*, May 1997. [http://preserve.harvard.edu/resources/digitization/matrix.html]

Colet, L. S., Keller, K., and Landsbert, E. 1997. 'Digitising Photographic Collections: A Case Study at the Museum of Modern Art, NY', *Spectra* 25 (2), 22-27.

Columbia University Libraries, 1997. 'Selection Criteria for Digital Imaging Projects,' [http://www.columbia.edu/cu/libraries/digital/criteria]

Conway, P. 1996a. 'Selecting Microfilm for Digital Preservation: A Case Study from Project Open Book', *Library Resources and Technical Services* 40(1): 67-77.

Conway, P. 1996b. *Preservation in the Digital World.* (Washington, D.C.: Commission on Preservation and Access).

Commission on Preservation and Access and the Research Libraries Group. 1996. *Preserving Digital Information, Report of the Task Force on Archiving Digital Information* (Washington, D.C.: The Commission on Preservation and Access).

Coppock, T. (ed.) 1999. *Making Information Available in Digital Format: Perspectives from Practitioners*. (Edinburgh: The Stationery Office).

Day, M. 1997. 'Metadata for Preservation', CEDARS Access Issues Working Group, (CEDARS Project Document AIW01), [http://www.ukoln.ac.uk/metadata/cedars/AIW01.html]

Digitisation of Library Materials: Report of the Concentration Meeting & Workshop. Luxembourg, 14.12.99, [http://www.echo.lu/digicult/en/digit.pdf]

Downton, A. C. and Impedovo, S. (eds) 1997. *Progress in handwriting recognition* (Singapore: World Scientific).

Eakins, J.P. & Graham, M.E. 1999. *Content-based Image Retrieval: A report to the JISC Technology Applications Programme*. Newcastle, Institute for Image Date Research, University of Northumbria at Newcastle, January 1999.

Elkington, N. E. (ed.) 1994. *Digital imaging technology for preservation* (RLG Symposium on Digital Imaging Technology for Preservation, Cornell University, Ithaca, New York, 17 and 18 March 1994) (Mountain View, CA: The Research Libraries Group).

Ester, M. 1996. *Digital Image Collections: Issues and Practice* (Washington, DC: The Commission on Preservation and Access).

Flickner, M., et.al. 1995. 'Query by Image and Video Content: The QBIC System', *Computer*, 18(9): 23-32.

Gladney, H.M., Mintzer, F., Schiattarella, F., Becós, J., & Treu, M. 1998. 'Digital Access to Antiquities', *Communications of the ACM*, 41(4), 49-57.

Greenberg, A. D. 1995. *Digital images : a practical guide* (Berkeley, CA: Osborne McGraw-Hill).

Hazen, D., Horrell, J., & Merrill-Oldham, J., 1998. *Selecting Research Collections for Digitisation,* (Amsterdam: European Commission on Preservation and Access).

Hendley, T. 1996. *The Preservation of Digital Material* (London: British Library Research and Development Department).

Hüfner, J. 1997. 'Steigerung der Erkennungsgenauigkeit durch maschinellen Abgleich verschiedener durch OCR erzeugter Volltexte (Increasing the Quality of OCR-generated Full Texts by Automatic Comparison)', *Nachrichten für Dokumentation* 48 (2), 79-85.

Ihrig, S. 1995. *Scanning the professional way* (Berkeley: Osborne McGraw-Hill).

Jenkins, F. R., Nartker, T. A., and Rice, S. V. 1996. 'Testing OCR Accuracy: Results of the Fifth Annual Test of OCR Technology by UNLV's Information Science Research Institute', *INFORM* September 10 (8), 20-25.

Johnson, N. F. and Jajodia, S. 1998. 'Exploring Steganography: Seeing the Unseen', *Computer* February 31 (2): 26-34.

Kenney, A.R. 1996. 'Conversion of Traditional Source Materials into Digital Form' in David Bearman (ed.) *Research Agenda for Networked Cultural Heritage* (Santa Monica: Getty Art History Information Program), 41-47.

Kenney, A. R. 1998. 'Digital to Microfilm Conversion: A Demonstration Project 1994-1996 (Final Report to the National Endowment for the Humanities PS-20781-94). [http://www.library.cornell.edu/preservation/com/comfin.html].

Kenney, A. R. and Chapman, S. 1996. *Digital Imaging for Libraries and Archives* (Ithaca, NY: Department of Preservation and Conservation, Cornell University Library).

Kenney, A. R. and Personius, L. K. 1992. *The Cornell/Xerox/Commission on Preservation and Access Joint study in digital preservation* (phase 1, January 1990-December 1991: digital capture, paper facsimiles and network access) (Ithaca, NY: Commission on Preservation and Access).

Kenney, A.R and Rieger, O.Y., 1998. 'Using Kodak Photo CD Technology for Preservation and Access: A Guide for Librarians, Archivists, and Curators', *Diginews* [http://www.library.cornell.edu/preservation/kodak/kodak-htm.htm]

Kenney, A. R. and Rieger, O.Y., 2000. "Moving Theory into Practice: Digital Imaging for Libraries and Archives," (Mountain View, CA: Research Libraries Group).

Kiernan, K. 1994. `Digital Preservation, Restoration, and Dissemination of Medieval Manuscripts' in Oakerson, Ann (ed.) *Scholarly Publishing on the Electronic Networks*, Proceedings of the Third Symposium, (Washington D.C.: ARL Publications) 15 [http://www.bl.uk/diglib/beowulf or http://www.uky.edu/~kiernan/welcome.html]

Kiernan, K. 1995. 'The Electronic Beowulf', *Computers in Libraries* (February): 14-15 [http://www.bl.uk/diglib/beowulf or http://www.uky.edu/~kiernan/CIL.html].

Knoll, A. 1995. *Digitization of Old Manuscripts* (Praha: Narodni knihovna).

Lee, S. 1999. *Scoping the Future of the University of Oxford's Digital Library Collections.* Final Report of study funded by the Andrew W. Mellon Foundation. Oxford, University of Oxford's Humanities Computing Unit, September 1999. [http://www.bodley.ox.ac.uk/scoping/]

McElhone, J. 1997. 'Electronic Imaging: Information Gathered at Two Events', *Spectra* 25 (1): 48-56.

Mantelman, L. 1994. 'Windows OCR Packages Put a Typist in Your Tank', *Imaging Magazine* (December): 8-25.

Mintzer, F., Braudaway, G.W., and Bell, A.E. 1998. 'Opportunities for Watermarking Standards', *Communications of the ACM*, 41(7), 57-64.

Niblack, W. and Flickner, M. 1993. `Find me the Pictures that Look Like This: IBM's Image Query Project', *Advanced Imaging*, (April): 32-35.

Okon, C. 1995. `IBMs Image Recognition Technology for Databases at Work: QBIC or Not QBIC?', *Advanced Imaging*, 10 (May): 63-65.

Oppenheim, C. 1997, Copyright in the electronic age. In: UNESCO *World Information Report*. Unesco, Paris: [http://www.unesco.org/webworld/com_inf_reports/wirenglish/chap26.pdf]

Ostrow, S.E. 1998. *Digitzing Historical Pictorial Collections for the Internet.* (Washington, DC: Council on Library and Information Resources).

Parry, D. 1998. *Virtually New - Creating the Digital Collection: a review of digitisation projects in local authority libraries and archives.* Final Report to the Library and Information Commission. Prepared by Consultants to the Review, Information North (London: Library and Information Commission). [http://www.ukoln.ac.uk/services/lic/digitisation/].

Podmore, H. 1998. 'The Digitisation of Microfilm' in L. Carpenter, S. Shaw, and A. Prescott (eds) *Towards the Digital Library: The British Library's 'Initiatives for Access' Programme* (London: The British Library), 68-72.

Prescott, A. 1997. 'The Electronic Beowulf and Digital Restoration', *Literary and Linguistic Computing*, 12 (3): 185-195.

Prescott, A. 1998. 'Constructing Electronic Beowulf' in L. Carpenter, S. Shaw, and A. Prescott (eds) *Towards the Digital Library: The British Library's 'Initiatives for Access' Programme* (London: The British Library), 30-49.

Prescott, A. and Pratt, M. 1998. 'Excalibur: Image-Based Text Storage and Searching' in L. Carpenter, S. Shaw, and A. Prescott (eds) *Towards the Digital Library: The British Library's 'Initiatives for Access' Programme* (London: The British Library), 178-189.

Puglia, S. 1999. 'Creating Permanent and Durable Information: Physical Media and Storage Standards' *CRM: Cultural Resource Management* 22(2), 25-27 [http://tps.cr.nps.gov/crm/archive/22-2/22-02-10.pdf].

RLG Working Group on Preservation Issues of Metadata, 1998. [http://www.rlg.org/preserv/presmeta.html]

Reilly, J.M., & Frey, F.S. 1996. *Recommendations for the Evaluation of Digital Images Produced from Photographic, Microphotographic, and Various Paper Formats,* Report to the Library of Congress, National Digital Library Project, Contract #96CLCSP7582. [http://lcweb2.loc.gov/ammem/ipirpt.html]

Robinson, P. 1993. *The Digitization of Primary Textual Sources* (Oxford: Office for Humanities Communication Publications, No. 4).

Robinson, P. 1994. *The Transcription of Primary Textual Sources Using SGML* (Oxford: Office for Humanities Communication Publications, No. 6).

Robinson, P. 1996. 'Image Capture and Analysis' in Christine Mullings, Marilyn Deegan, Seamus Ross, & Stephanie Kenna (eds) *New Technologies for the Humanities* (London: Bowker Saur), 47-64.

Schantz, H. F. 1996. 'Optical Character Recognition -- The Mature Technology with the Brilliant Future', *INFORM* July/August 10 (7): [http://www.aiim.org/infoservices/index.html].

Sharpe, Louis, H., Ott, Michael D., Fleischhauer, C. 1998. *Library of Congress Manuscript Digitisation Demonstration Project, Final Report.* [http://memory.loc.gov/ammen/pictel/pictel.pdf]

Smith, A.1999. *'Why Digitize?'*, Washington D.C., Council on Library and Information Resources. [http://www.clir.org/pubs/reports/pub80-smith/pub80.html]

SOLINET, 1996. *To Scan or not to Scan,* (Atlanta: SOLINET--The Southeastern Library Network, Inc).

Tanner, S., and Robinson, B. 1998. *JISC Image Digitisation Initiative (JIDI): Feasibility Study (Final Report)*, [http://heds.herts.ac.uk/Guidance/JIDI_fs.pdf]

Thompson, C. 1997. 'OCR/ICR Accuracy and Acceptance - What Does it Mean?', *INFORM* July/August 11(7): [http://www.aiim.org/infoservices/index.html].

Townsend, S., Chappell, C. & Struijvé, O. 1999. *Digitising History: A Guide to Creating Digital Resources from Historical Documents*. AHDS Guides to Good Practice. [http://hds.essex.ac.uk/g2gp/digitising_history/index.html]

Wayner, P. 1993. 'Optical Character Recognition: an inside look at how optical character recognition works', *Byte* December 18 (13): 203-210.

Weber, H. and Dörr, M. 1997) *Digitisation as a Method of Preservation* (Amsterdam: European Commission on Preservation and Access).

Whitfield, S. 1998. ‘A Database for Cataloguing Chinese and Central Asian Manuscripts: The International Dunhuang Project’ in L. Carpenter, S. Shaw, and A. Prescott (eds) *Towards the Digital Library: The British Library's 'Initiatives for Access' Programme* (London: The British Library), 166-177.

Key Web Resources:

Stanford
http://palimpsest.stanford.edu/bytopic/imaging/

Berkeley Digital Library Sunsite
http://sunsite.berkeley.edu/Imaging

RLG DigiNews
http://www.rlg.org/preserv/diginews

See Manfred Thaller's Duderstadt project, which used grey-scale images to digitise the entire archives of a small German town.
http://www.archive.geschichte.mpg.de/duderstadt/dud-e.htm